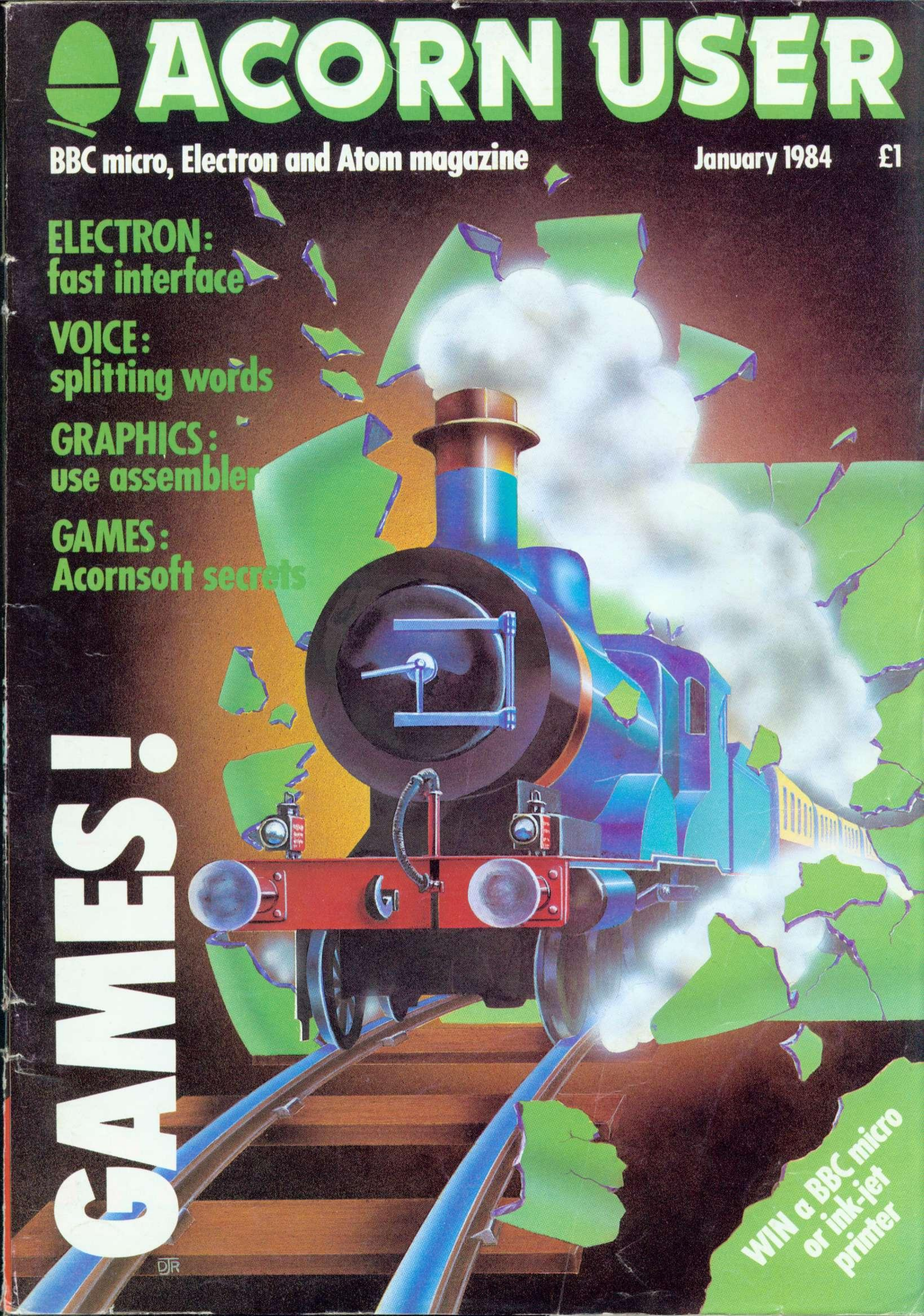
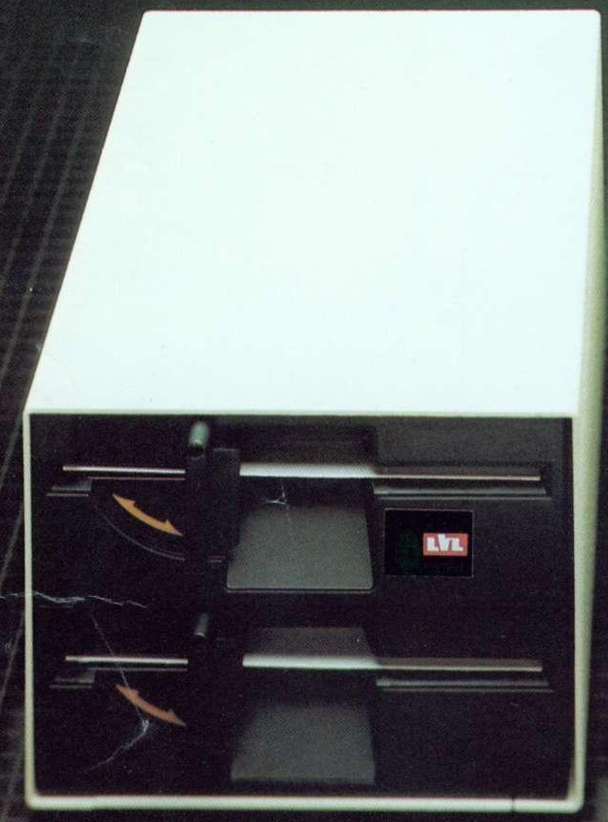
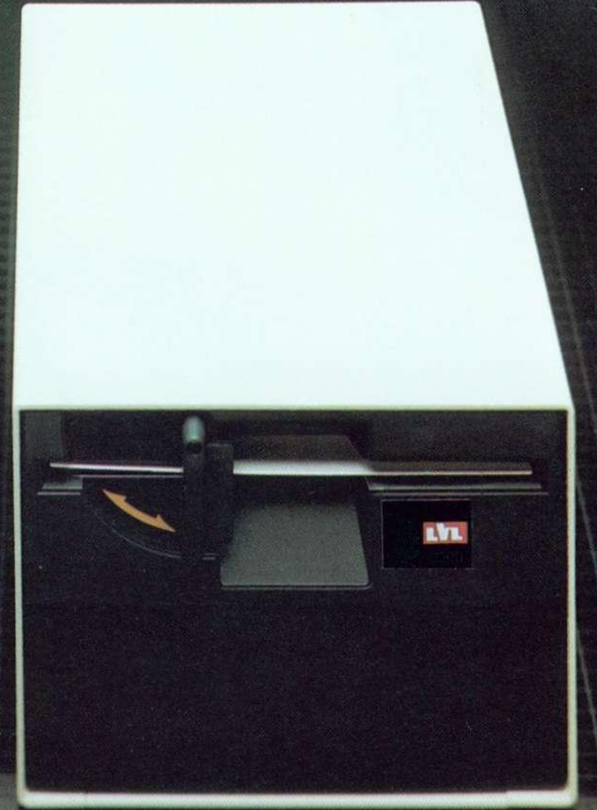

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BBC micro, Electron and Atom magazine
January 1984
£1
ELECTRON: fast interface
VOICE: splitting words
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GAMES!
WIN a BBC micro or ink-jet printer
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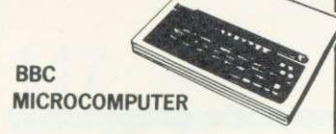
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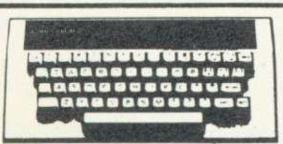
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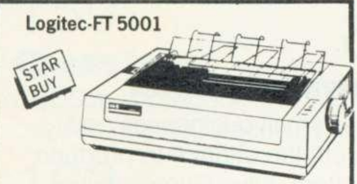


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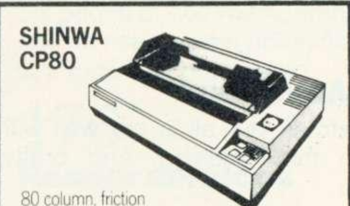
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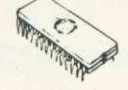
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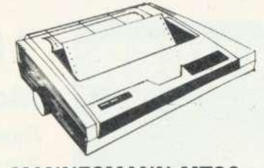
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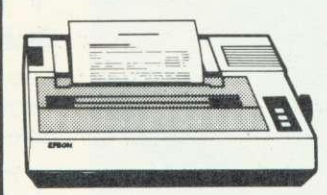
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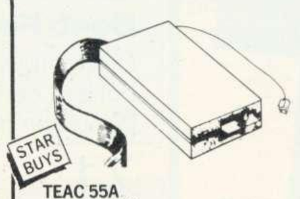
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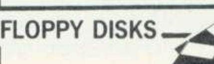


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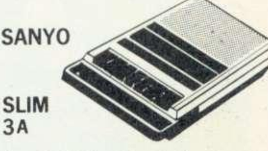
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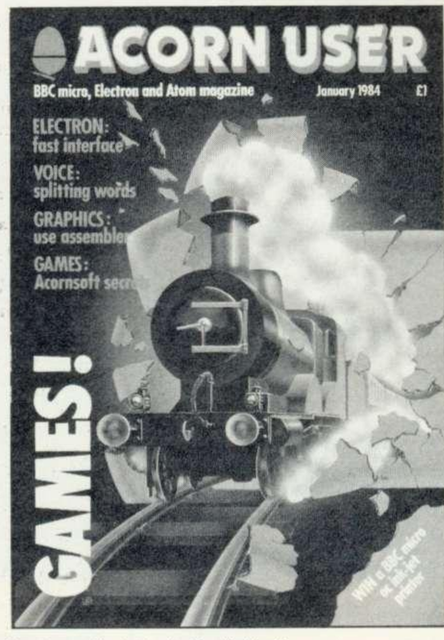
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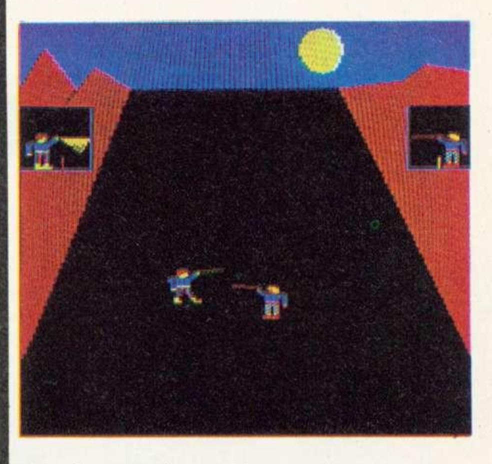
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3in discs, Prestel adapters, RAM extension cards, second processors – they're all under way

Authors please note

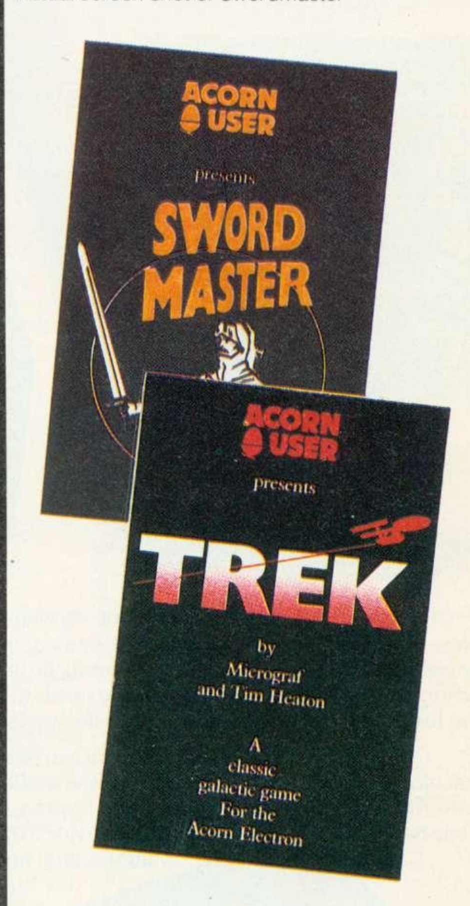
We've been inundated with articles for publication – many of an extremely high standard. It takes time to read them, try listings out and edit them – which is the only way to maintain standards. Also remember that magazines work at least two months in advance.

So please bear with us if you hear nothing for weeks (although all submissions are acknowledged).

Thanks for your patience and apologies for any frustration caused.



Actual screen shot of Swordmaster



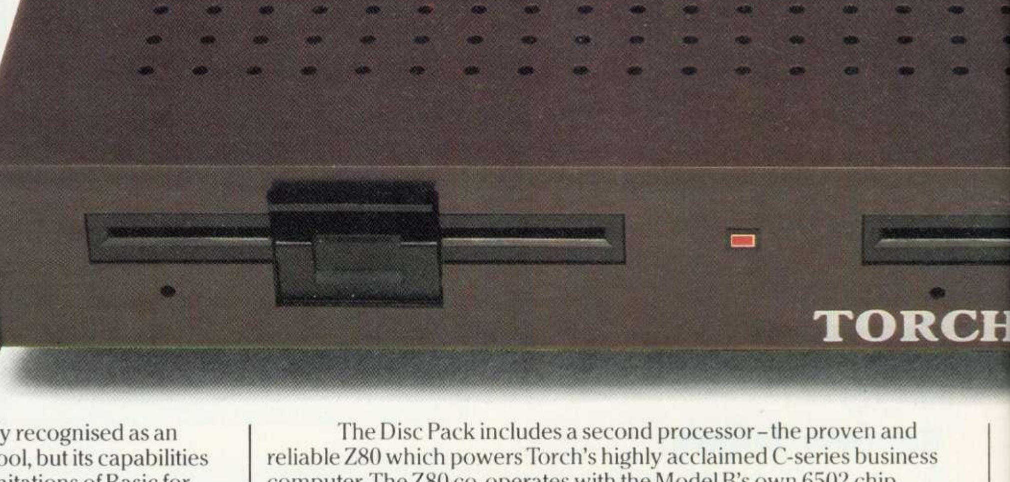
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TWO games are now available from *Acorn User*. They are Sword Master (BBC B and Electron) and Trek (BBC B and Electron). Both make extensive use of the excellent graphics, speed and sound of the machines. **Turn to page 10 for details.**

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ISSN: 201-17002 7

The best thing next





The BBC Model B microcomputer is widely recognised as an impressive first computer for the home or the school, but its capabilities are restricted by its lack of data storage and the limitations of Basic for serious programming. For the user who needs more from this computer the Torch Z80 Disc Pack is a gateway to the world of advanced computing.

Model B's fitted with disc interface can be upgraded to full business machines by the Torch Z80 Disc Pack thereby offering the use of more powerful and flexible languages such as Fortran, Pascal, BCPL and Cobol, while twin 400K disc drives provide a massive storehouse for information and rapid data transfer from disc to processor.

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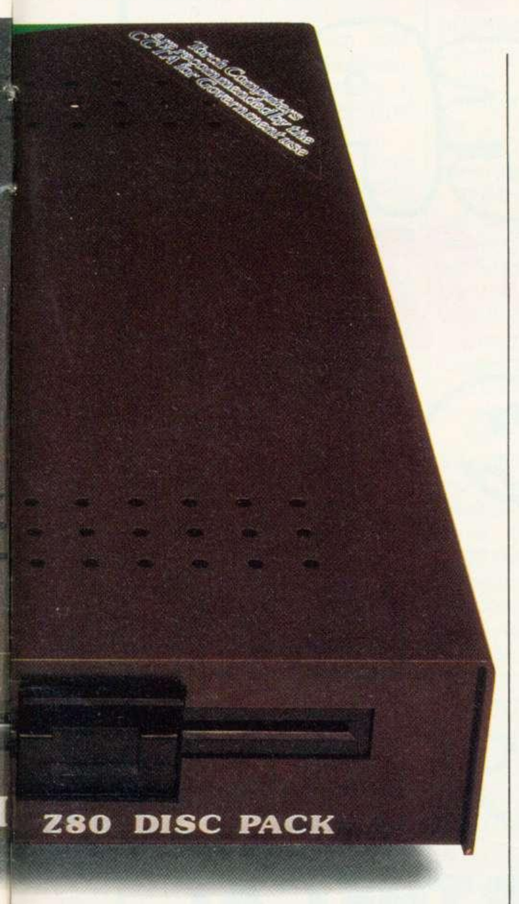
In addition to accepting the BBC's extensive range of software, the Z80 Disc Pack supplies Torch's own CP/M® – compatible Network operating system, based in Read Only Memory (ROM). This advanced design means that almost all of the 64K of Random Access Memory (RAM) provided on the Z80 board is available for CP/M programming use – an advantage that no other BBC micro upgrade can offer.

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by PrImer Educational Software

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by Widgit Software

Two mind-stretching, space-age games to test mental arithmetic and nimble fingers. In **Sum Vaders** alien robots invade the earth. Only quick thinking and fast reactions can prevent them. Several levels of difficulty and a two-player game with a handicap option make Sum Vaders equally testing for all family members, from 8 years to adult.

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by Andromeda Software

Meet Caesar, a cheeky young cat on duty in a well-stocked larder. He's kept busy chasing a gang of hungry mice eating the family's food. Playing against the clock, you guide Caesar along crowded shelves to pounce on the mice.

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Winchester networks

PACE, who do the Amcom DFS, have announced a Winchester-based network aimed at schools. E Net is the name and up to 250 BBC micros can be linked.

At just under £2000 for a basic system, it isn't cheap, but then the Winchester hard disc holds 10Mbyte of memory and can be upgraded to 140Mbytes.

Each station on the network can be given a priority level, and allocated a certain amount of memory. The overseeing teacher has complete control of all users and can assign a password and station number to each user. These must be typed in before that station can be used.

The teacher can view any screen on the network at any time and send messages to all or selected stations. This means advice or instructions can be passed to a pupil who is having problems.

Printers can be shared by the machines on the system, or attached to each.

The micro which is reserved for the role of 'file server' can be used as printing takes place, because a buffer in the Winchester takes care of the data.

Pace are at 92 New Cross St, Bradford BD5 8BS.

Cool memory

NO LESS than three memory extension boards are produced by Ramamp Computers.

All three are designed to fit under the BBC micro's keyboard, rather than over the RAM area, to reduce the possibility of overheating.

They also avoid the need to bend any of the power supply pins in the RAM area, says Ramamp.

The ROM extension board provides six extra chip slots; the RAM board adds up to 16k, while the ROM/RAM extension gives four ROM slots plus an extra 16k of RAM.

Details are available from Ramamp at 25 Avon Drive, Whetstone, Leicester. The company also produces a two-watt sound amplifier.

Queen takes Beebs

BUCKINGHAM Palace had Acorn chiefs in a right royal flap shortly before the Queen set off for the Commonwealth Conference in India . . . when Her Majesty decided the BBC micro would be her official gift to the Indian people.

But it was without doubt the highest compliment the Beeb has ever received and the company pulled out all the stops – plus a number of 6502 second processors.

Half a dozen six-station Econet systems were presented by the Queen to the Indian President Mr Zail Singh shortly before the conference began.

The machines are to be used in education, where the Indian government sees a great potential for Beebs. In fact 200 more machines have been ordered, and the £700,000 deal could lead to Beebs being assembled in India.

Acorn only knew about the gift three weeks before they were handed over.

Six Econets are official gift to Indian President

Each of the systems arrived in India complete with a 6502 second processor – though this meant whipping three of the rarities from exhibition stock due to be shipped to America for the Comdex show.

According to Tom Hohenberg, the company's marketing manager, the idea to give BBC computers as a present was the Queen's own.

So is there a Beeb user group at the Palace? Does Di play *Snapper*? Does William like *Killer Gorilla*? A discreet silence from Cambridge.

But the company makes no secret of its pleasure at the decision.

'We are absolutely delighted that the Queen should consider that our product will make a significant contribution to Indian education,' says Tom Honehberg.

One obvious problem of course is how the machines will be serviced and maintained.

They were taken to India and set up by Lawrence Hardwick, one of Acorn's customer service experts.

But what happens when . . . well, any long-term Beeb user can think of things that can go wrong and need a bit of adjustment.

What will happen to the Indian machines? Good question, says Hohenberg, but unfortunately there is not yet a clear answer.

However, the market potential of the sub-continent is well recognised by the company, which is busy wooing several foreign governments to introduce BBC micros into their education systems.

Arrangements for supplying the gifts were personally supervised by Acorn's managing director, Chris Curry.

So could this be described as an Indian Curry? Only at your peril, warns Hohenberg.



£20 on Digger and Roz

OUR two high-flyers this month are Roz Evitts and Sean de Bray of the Visions software factory. And what we want you to do is to put a humorous caption to their picture (£20-worth of software to the winner, entries by Feb 5).

Visions has just added the zanily-named *Pengi* and *Digger* to its *Snooker* and *Dare Devil Dennis* BBC games (there's also an Electron *Snooker*). All the games cost £7.95, apart from the Snookers which are £1 more. Two new releases, *Sound Studio* and *Paint Box* are planned for the New Year at £14.95 each.

Project to help disabled students

A NEW college course on assessing the needs of physically disabled students in further education has been set up – equipped with Beebs.

The two-year project at Hereward College, Coventry, will look at developments in information technology. The college is buying equipment for an assessment programme which will be used with external students from next year.

Each of the 15 students in 1984's intake will be equipped with a BBC model B, disc drive, monitor and printer.

Hereward will work with a team from Warwick University involving both the psychology and the industrial and business studies departments. Warwick research funds will be used to help produce an integrated system providing word-processing, calculation and graphics on BBC micros.

The project is backed by the Department of Trade and Industry and requires analyst/programmers to join the team. Anyone interested should contact Geoff Stevens, Industrial and Business Studies, Warwick University, Coventry CV4 7AL. (Tel: 0203 24011, ext 2456.)

Taking the drudge out of drugs

DISPENSARY is a software pack for pharmacists which runs on the Torch and BBC micros.

It comes on disc at £70 or in EPROM at £75 and is capable of stock control, age analysis and labelling.

The main menu has nine options: print labels; update drug file; view a drug; update direction file; update suffix file; update warning file; print sales report; sort drug file; and finish.

A minimum system with a 100k disc drive can handle 1000 drugs at a time, although the addition of further drives will increase this capacity considerably.

Each drug has its own file holding the following information: name; code; suffix code; warning code; PIP code; quantity used to date; supplier's code.

Dispensary is designed to be used with a dot matrix printer to produce the drug labels and reports.

A R Computers, who have released the package, are at Market Lane, Ipswich IP1 1BN.

40/80 disc choice

ACORNSOFT discs will in future come in a format that is readable on 40 and 80 track drives. Sounds like a good idea. Wonder which of the major software houses is going to be the first to offer cassette-disc upgrades on programs?

Fonts in ROM

FROM Watford Electronics comes this press release advertising the Beebfont monitor ROM. The letter neglected to mention the price, but no doubt Watford can fill you in on that.

The picture on the right shows the press release reduced to slightly less than half size (it was originally on A4 paper). It was printed using a dot-matrix machine.

This is a sample printout from our new "BEEBFONT" monitor ROM.

It is a very clever ROM. One can create any character including Chinese and Arabic.

Can I please request you to mention this in the news section of the next issue of Acorn User.

Liberal micro alliance

IT HAD to happen. Home micros are going into local politics. And already it is clear that a favourite candidate for your constituency computer is the Beeb . . . probably in alliance with the Electron.

Appropriately enough, the idea for this Acorn alliance comes from half of the other alliance, the Liberals. They are setting up a party network based upon the privately-owned micros of their members throughout the country.

The network was launched last September at the annual assembly in Harrogate. It is called 'Micro Lib' (what else?) and is seen as an important new way for the party to organise wards and constituencies.

The first obvious problem in setting up a network is, of course, the difficulty of coping with the different types of machines available.

Though Sinclairs of various sorts make up the biggest number of home micros on the group's list, the Beeb is the single most popular machine – and there are already one or two Electron owners registered. This has led Micro Lib's co-ordinator, David Graham, to forecast that an Acorn alliance could be just the answer for local parties.

He sees the BBC being the standard machine for many constituencies – but with ward and branches equipped with Electrons.

According to the Liberals, the potential for home computers in the battle for the polls, though still unclear, is enormous. Among the most obvious uses, of course, are boring old files, membership, helper, and supporter lists, plus branch and constituency funds.

But the Liberals are very keen on what they call 'community politics'.

This involves producing large numbers of local newsletters, usually produced at home on small printing machines, but 'typeset' on ordinary portable typewriters. The result is less than professional in appearance.

Now the advent of 'computerised community politics' offers prospects of wordprocessed papers using *View* or *Wordwise*.

Further in the future, Micro Lib is looking into the possibility of a national network linked over the telephone system by modems. But the group admits it is still feeling its way and the most immediate plans are a one-day conference next February in Wimbledon to prepare for next spring's local elections and the Euro-elections next summer.

One can only assume – after Micro Lib – it cannot be long before we have Micro Soc Dems, possibly Con Comps and Micro Labs.

Digital images from video

VIDEO cameras and micros can get together with an interface from Educational Electronics.

The device accepts signals from sources such as video cameras, VHS players and video discs. These images are then digitised and displayed with a maximum resolution of 220 × 312 pixels, in 64 shades of grey.

Once digitised, pictures can be saved to disc or analysed by other software.

A machine code program is supplied with the interface (seen at the front of the picture), and it comes with a cable to the user port for £200.

Digitising a picture takes about four seconds, which can cause distortion of a moving image. Educational Electronics offers a software writing service for specialist applications.

Details from the company at 30 Lake St, Leighton Buzzard, Beds LU7 8RX.



The interface from Educational Electronics (foreground of picture) which can digitise a video image in about four seconds. Pictures can be taken from a video camera, VHS player or disc. Interface plus machine code program cost £200.

Ham it up on a micro with RTTY

TAPPING into transmissions from the likes of Russia's Tass and London's Reuters is possible on the BBC micro.

Ham radio enthusiasts have for years been tuning into such transmissions, called radioteletype (RTTY). Now, through the Beeb, news agency broadcasts can be decoded and displayed in English on a monitor.

A device to do just this, and information about RTTY in general is available from J Melvin, 2 Salters Court, Gosforth, Newcastle NE3 5BH.

Summer camps

CHRISTIANS, led by *Acorn User* author Paul Beverley, are to run a holiday for 13-16 year old boys. The aim is to give them the opportunity to learn more about computers and electronics.

Micros will be used to control model trains, cars, robot arms etc, with sessions on simple electronics and programming, and some assembly language if there is a demand. Interfacing electronic equipment to BBC micros will be a prime aim. The cost of the camp is £48 for a week.

The camp comes under the auspices of the Inter-Schools' Christian Fellowship and there will be a chance in the evenings to learn more about what it means to be a Christian in today's world.

There are two one-week camps: 11-18 and 18-25 August. For details, contact Mrs Sue Beverley, 57 Cambridge Street, Norwich NR2 2BA.

Games weekend

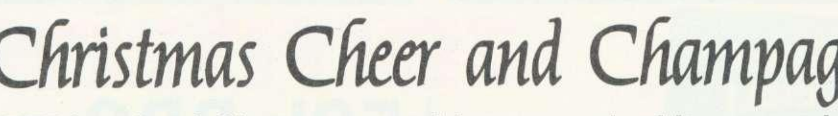
WRITING games in Basic is the title of a weekend course at Horncastle Residential College in February, and a second session on programming will follow it.

Applicants should have a 'reasonable knowledge' of Basic, and are encouraged to take their BBC micros along, to add to those already available.

The games weekend will be February 17-19, and the programming will be held mid-week on February 20-22. More facts from Horncastle Residential College, Mareham Rd, Horncasle, Lincs LN9.6BW.

Network theory

NETWORKS 84 covers the theory and design of local and international systems and takes place at the Wembley Conference Centre in London on July 3-5. Online are the organisers at Pinner Green House, Ash Hill Drive, Pinner, Middx HA5 2AE.



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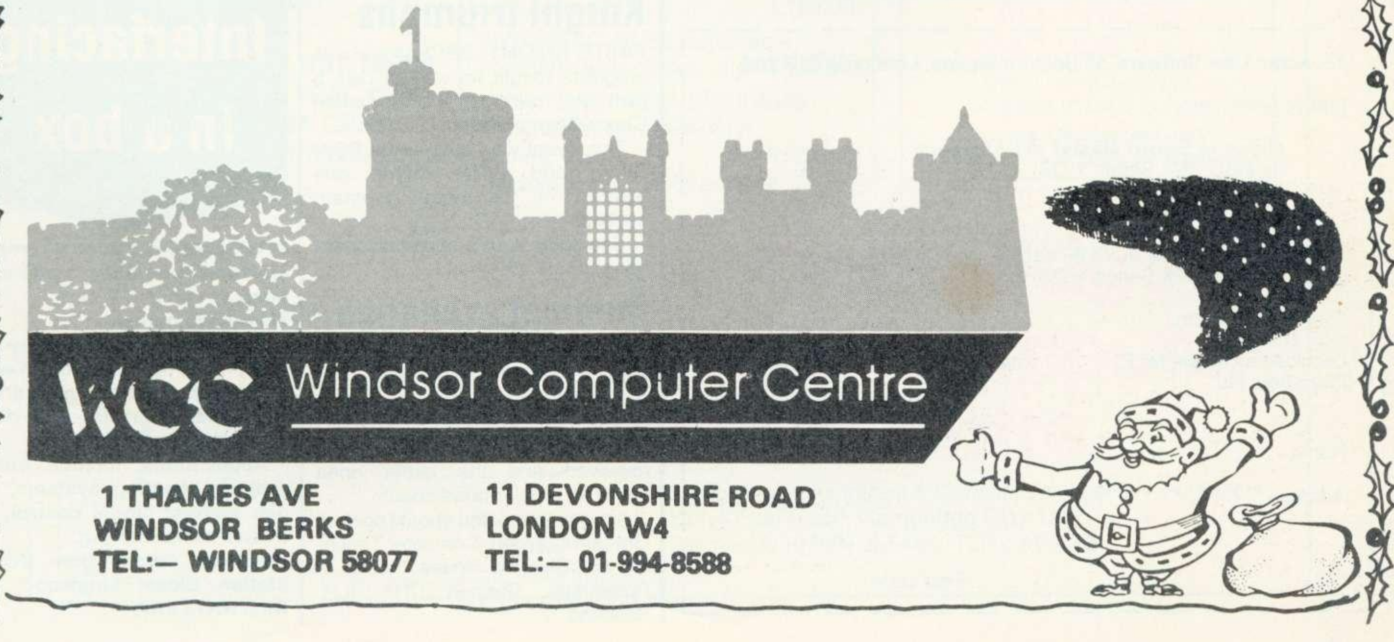
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52k BBC micro

ARIES B20 is the board that adds a potential 20k to the BBC micro – which means you can run programs in the highest graphics mode and still have 28k left.

The board has virtually no effect on processing speed, says Peter Headland who heads Cambridge Computer Consultants, makers of the board. The only difference is that operating system calls are slowed down by something less than 1 per cent.

Software which uses legal OS structures works with the board – including *View*, and Acornsoft's versions of BCPL, Lisp and Forth. Also, the board will work with the second processors.

Headland, who at one time worked for Acorn, added that the board makes use of an unused *FXcall – 111 – which was sanctioned by Acorn. (He had originally wanted to use *FX80, but this is reserved for something else!)

Games which make use of direct screen access for speed, such as Acornsoft's, are coped with by the board. It merely provides a command which switches back to normal BBC micro operation.

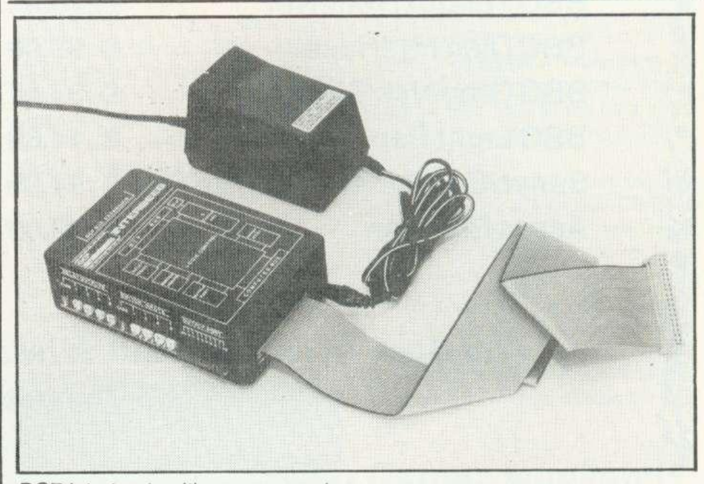
The Aries fits inside the BBC's case and extends memory up to &7FFF, whichever screen mode is selected. In Basic, HIMEM is always &8000.

Major advantages of the board will include a four-fold increase in the size of files with *View* when in mode 0.

Also, programmers will be able to take advantage of the improved screen layouts in 80-column modes with Lisp and other highly-structured languages.

The board can be fitted in five minutes using just a screwdriver, says Headland. No soldering, no cutting tracks or links.

It costs £99.95 from Cambridge Computer Consultants, FREEPOST, Cambridge CB1 1BR. Tel: (0223) 210677.



DCP Interbeeb with power supply

Knight triumphs

WHITE KNIGHT, BBCSoft's chess program, fought its way to take a joint first prize at the European Chess Championship.

The Event was held at the PCW Show, and *White Knight* was entered in the home program section.

See John Vaux's appraisal of the game (page 159).

Medical exchange

THE Assocation for the Study of Medical Education is setting up a group for exchanging information on computer-based material.

Commercial teaching aids will be reviewed and the better ones shown in regular news sheets.

Anyone interested should contact Graham Clayden, Computer Teaching Aid Clearing House, ASME, 2 Roseangle, Dundee DD1 4LR, Scotland.

Interfacing in a box

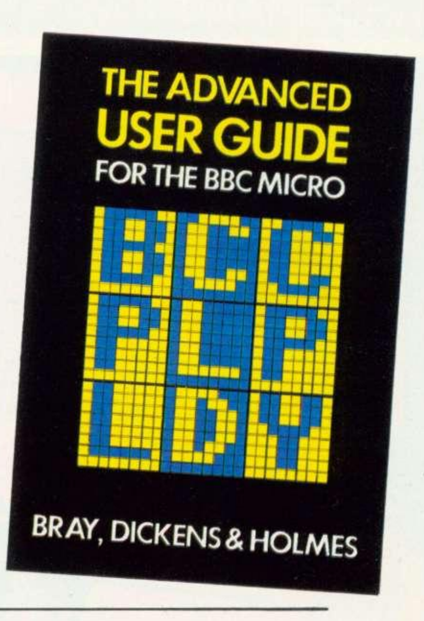
INTERBEEB provides a complete electrical interfacing system in a neat box, says DCP Microdevelopments.

Each unit has four relay outputs, four switch inputs, an eight-bit input port, output port, and an eight-channel analogue to digital converter. It costs £60.

Applications include control projects, heating systems, burglar alarms, model control, and industrial monitoring.

Further details from DCP, 2 Station Close, Lingwood, Norwich NR13 4AX.

Christmas gifts from Cambridge!



The Advanced User Guide for the BBC Micro:

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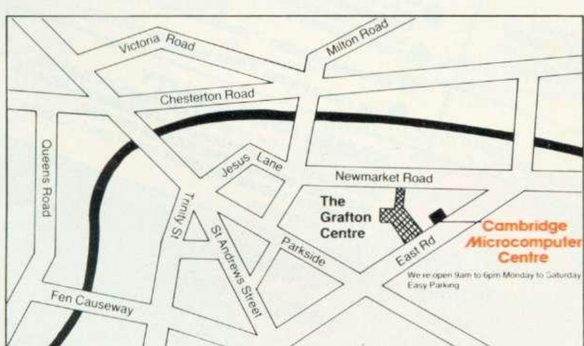
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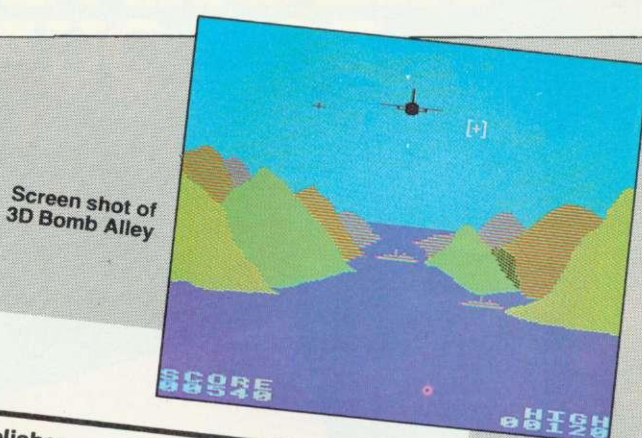


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Screen shot of 3D Bomb Alley

Game	Publisher	Cassette	Disc
1 3D Bomb Alley	Software Invasion	£7.95	£11.95
2 747 Flight Simulator	Doctor Soft	£8.95	£11.95
3 Killer Gorilla*	Program Power	£7.95	
4 3D Deep Space	Postern	£7.95	
5 Planetoids	Acornsoft	£9.95	
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8 Oblivion	Bug Byte	£7.50	
9 World Travel	Simon Hessel	£6.95	
10 Creative Graphics	Acornsoft	£9.95	
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12 The Sentinel	PSS		
13 Gunsmoke	Software Invasion	£7.95	£11.95
14 Hunchback	Superior Software	£7.95	£11.95
15 Monsters*	Acornsoft	£9.95	
16 The Hobbit	Melbourne House	£14.95	
17 Q*Bert	Superior Software	£7.95	
18 Sea Lord	Bug Byte		
19 Beeb Art	Quicksilva		
20 Chess*	Program Power	£7.95 (£5.95)	

*available on the Electron

Bubbling under: Space Adventure, Virgin; Landfall, Virgin; Firehawks, Postern; Starship Command, Acornsoft; Snowball, Level 9; Lunar Rescue, Alligata

The chart was compiled by MRIB Computer, London, and is based on sales returns from mid-September to November 1


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Simon Dally offers a BBC model B and two Olivetti printers (worth £350 each) as prizes

SEPTEMBER COMPETITION RESULTS

SEPTEMBER's competition for the first level of the dungeon beneath the *Acorn User* offices generated an enormous response: over 600 entries were received from people eager to win the printer.

A particular source of amusement was the picture postcard brigade, including readers in Australia. Honourable mentions in this category go to P Lewis and Alan Cox of Brighton, who managed to send in between them a dozen postcards featuring the more attractive parts of that pleasant town's nudist beach! Well, it was more interesting than the party political conference going on there when I was reading the entries!

Others interesting postcard-senders were Marcus Goodey of Colchester, who sent us a patriotic Union Jack, Peter Lumb of Berkhamsted, who opted for some aggressive-looking lions and Adrian Welch of Aberdeen, whose offering featured a disgusting-looking half-eaten salmon on a bed of dried-out old lettuce!

Others of you preferred ribald commentary. 'Why not make them tax inspectors and insurance salesmen instead of dwarfs and trolls?' asked Andrew Newton of Derby.

A full list of the solutions will be published, along with an explanation of the dungeon characters in two or three months time, when entries for the other two competitions have been received. The correct combination was 10836728, which half of the entrants got right. Owing to a couple of ambiguities in the wording, not least the remark that you always worked in positive integers, a few other solutions were admitted as well.

A word of warning: the first correct entry out of the bag came from Liverpool but had no name or address on it. Quite a lot of you in your fervour do this: the only beneficiary is the Post Office.

So, the winner of the Seikosha printer was Jonathan Farmer of Selby, Yorks.

PART ONE

The first problem is designed for the younger members of the family to attempt before they get any help.

American currency includes a nickel (five cents) and a quarter (25 cents). There are 100 cents to the dollar.

A currency reform enthusiast once proposed the introduction of a new coin called the grobble. He declared that using grobbles and quarters only (and at least one of each) he could form the sum of $100 in 14 different ways.

If a grobble consists of an exact number of nickles what is the highest amount of cents it could be worth?

WHEN you've completed all three parts, send you entry to January Competition, *Acorn User,* 53 Bedford Square, London WC1B 3DZ to arrive not later than February 3, 1984.

Customers	COINS															Retail
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	value
Adam	10	3	2	3	18	15	13	7	15	11	15	7	9	9	23	4688
Ben	14	24	20	25	23	24	7	1	10	15	9	4	11	13	11	4828
Carl	9	0	25	3	7	14	5	17	1	13	7	15	4	18	20	4861
David	22	23	12	3	25	19	13	24	14	10	13	20	24	16	10	7097
Eddy	24	8	18	17	22	24	18	25	5	11	18	25	22	21	10	7649
Fred	15	14	5	20	1	11	7	10	22	24	15	7	8	2	11	4191
George	25	1	22	17	23	23	18	4	17	21	20	2	6	17	22	5970
Harry	20	17	10	22	16	12	4	11	10	6	8	3	17	13	22	5275
Iris	4	14	12	23	8	18	20	17	1	15	14	15	2	22	15	5322
Jane	14	23	6	6	16	19	8	20	23	20	2	18	12	14	25	6172
Kate	24	2	15	1	13	9	10	17	5	0	14	24	16	18	3	5278
Len	25	15	15	15	23	14	18	7	15	13	2	1	0	1	18	3395
Mike	7	18	10	24	24	15	11	24	5	19	0	22	18	23	8	6133
Nigel	18	2	17	0	19	13	13	23	3	16	14	15	21	20	24	7147

What each customer got in his bag

PART TWO

THIS problem is for everyone. A coin dealer decided one day to get rid of some excess stock he had of 15 varieties of coin. He hit on the idea of a 'lucky dip', that is he made the coins up into 14 bags containing a random number of coins. These he sold at £4000 a bag.

As this was quite a good deal he had no trouble in selling his bags. The figure shows what the customers found inside.

If a bag containing one example each of all the 15 coins would be worth £411 at normal retail prices, what was each coin worth?

PART THREE

Clues down

1 ET once constructed a means of linking BBC micros . . . (6)
2 . . . no kidding, but it has a negative value (4)
3 Sounds like profane programmer's editing aid (6)
4 Latest issue of Acorn's DOS? – let it go! (7)
5 Graphics command on the allotment? (4)
8 Discs and cassettes, etc might give you star ego (7)
9 One who allows a non-numeric symbol (6)
13 Frenchman, following fashion, gets an add-on unit (5)
15 Program failure – hand round the fags! (5)
17 Error message causes no anger (2,4)
18 Unaccommodating error message (2,4)
20 Colour to see mother embracing a spy (7)
23 Animated screen effect upsets priest (6)
25 What a dollar gets you, basically? (6)
27 Somewhat medieval way of getting the computer to do a calculation (4)
29 A pseudo-variable the old lag's seen a lot of (4)

Clues across

6 The squirrel's monthly? (5,4)
7 A screen effect used off and on (5)
10 Ernest madly presses the return key (6)
11 The micro to make Ronald an MP (8)
12 A cat – Acorn's first? (4)
14 It's soft just pressing break! (5)
15 Nancy loses her head and goes peculiar colour! (4)
16 In gold a jumbled message for the cassette user (7)
19 Shopping avenues setting the standard for computer games? (7)
21 A common seaside feature, it can't be erased (4)
22 Studies at university as the computer accepts data (5)
24 Symbol that's a real mess? (4)
26 Comprehensive sound command – it may need addressing (8)
28 Confused tuner after right key (6)
30 Hold up part of Model A, you! (5)
31 Something to be said for a programming instruction (9)

● Crossword set on a BBC micro, and printed on an Epson by Eddie James

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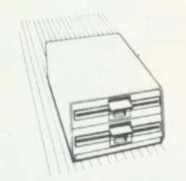
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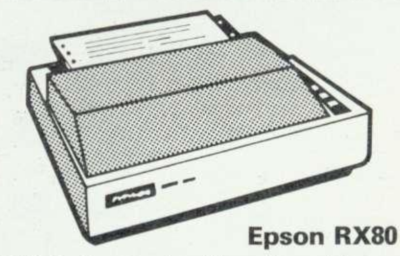
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Without a doubt, the most sophisticated DFS Software yet written for BBC Micro Computer. This powerful new DFS is fully compatible with ACORN DFS yet has much increased power due to additions, carefully designed to make life easier in normal use. It consists of over 14K of effeciently written machine code. It is entirely self contained and so does not require a utilities disc to function.
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* A WORKFILE function sets the name to be used when the null filename is issued. This allows a program to be edited and repeatedly saved having only typed its name once.
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USING GRAPHS

Stan Froco considers applications for undirected graphs

AT THE end of last month's article I left you the problem of how to find your shortest route once you had calculated its length using Dijkstra's method. The solution is simple. An array p% is declared with one member for each point in the graph being considered. Each element of this is used to hold the previous point, used on any shortest route to the element being considered. Thus p%(3) would hold the previous point on any shortest route to point 3.

This is updated after line 850 of the listing I gave last month. If d%(nearest%) + c%(nearest%,j%) is less that d%(j%), then we can set p%(j%) to be nearest%. At the end of run p% will be complete. To find the route to, say, point 5 from point 1 we start at the end and work backwards. We look at p%(5) to find the point leading to it. We can then look for the point leading to this, and so on until we get to point 1. A small recursive procedure does this easily.

I will now consider another use of graphs, which has an important application within the computer industry. We saw last month that a graph consists of a number of vertices connected by a number of edges. A graph can be either undirected, in which case the distance from vertex a to vertex b is the same as the distance from vertex b to vertex a, or directed, in which case the distance between vertex a and vertex b can be different from the distance between vertex b and vertex a.

It can be seen that an undirected graph is a special case of a directed graph, in which any connected vertices can be thought of as being joined by two edges, one in each direction, both of the same length. It is sometimes also convenient to think of unconnected vertices as being connected by edges of infinite length.

Of the graphs 1, 2 and 3, figure 3 is special in that there is only one route between any two points. Such a graph is called a tree, and this is the type of graph that I'll be considering here.

When designing electronic circuitry, it is often necessary to wire together a number of points on a circuit board. If the circuit is to handle high frequency signals it is often important that the points be connected only by one route to each other point. Cycles in the wiring could lead to problems such as signal corruption or oscillation. In the past this could be solved by hand, but the development of computers has led to a manifestation of the problem that needs mechanical assistance.

The back-plane of a large mainframe computer consists of a large array of hundreds or thousands of points which must be connected in complex circuits by thousands of wires. For obvious reasons the signals must not be corrupted, and so it is important that the wiring be designed with only one route to each point. It is also important that the wiring pattern should use as little wire as possible to reduce the cost and, more importantly, to cut down the room taken up by the wire.

Such a network of points connected each by only one route is, of course, a tree. A tree whose edges total the least possible length is called a minimum spanning subtree (MST). The graph in figure 4 is not a tree, but we can select some of the edges to build three trees, visiting all the vertices.

Of the three possible trees the second has a smaller total edge-length and so is the MST.

We can make a number of observations about trees. When we add an edge to a tree it ceases to be a tree and becomes cyclic.

We may remove any edge in the cycle to obtain a tree again (possibly a different one).

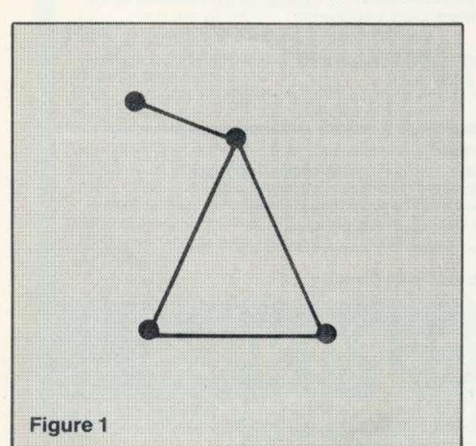
One way of constructing an MST is to find all the cycles and remove the component in each cycle which has the greatest length. We are then left with the MST. Another way is to start with a smaller MST that only uses some of the vertices in the graph. We can than make this bigger by adding edges to the other vertices, one at a time.

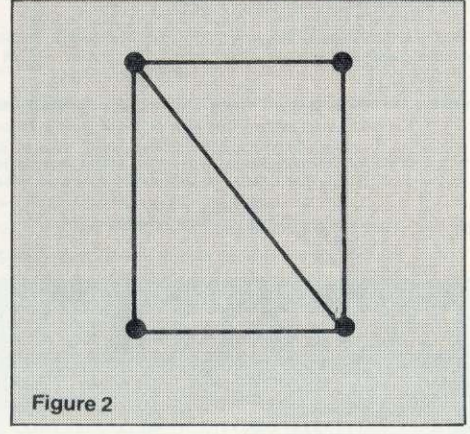
We must make sure that any edge we add has one end in the existing MST and one end not. The MST will then remain a tree. If we always add the shortest edge then the tree we obtain will also be an MST. This is called Prim's Method and is shown in listing 1. The simple MST we start with is just one vertex (I have used vertex 1). The graph I am using is shown in figure 5 (distances in brackets).

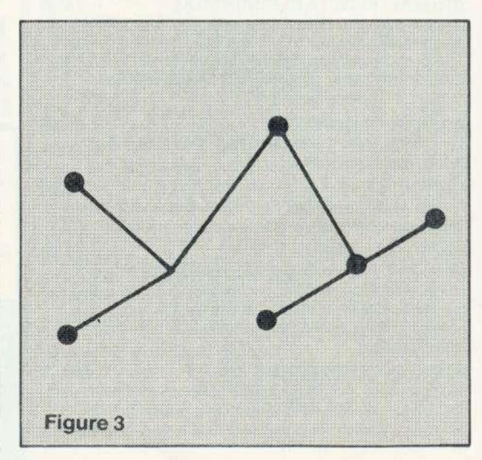
The graph is represented by an adjacency matrix c% set up from DATA at data% (lines 540-600). Since this is an undirected graph, distances in both directions are the same and are set up as such in lines 570 and 580. Unconnected points on the graph are set to infinity% apart, a distance much larger than any used elsewhere in the program and thus suitable as an approximation to infinity.

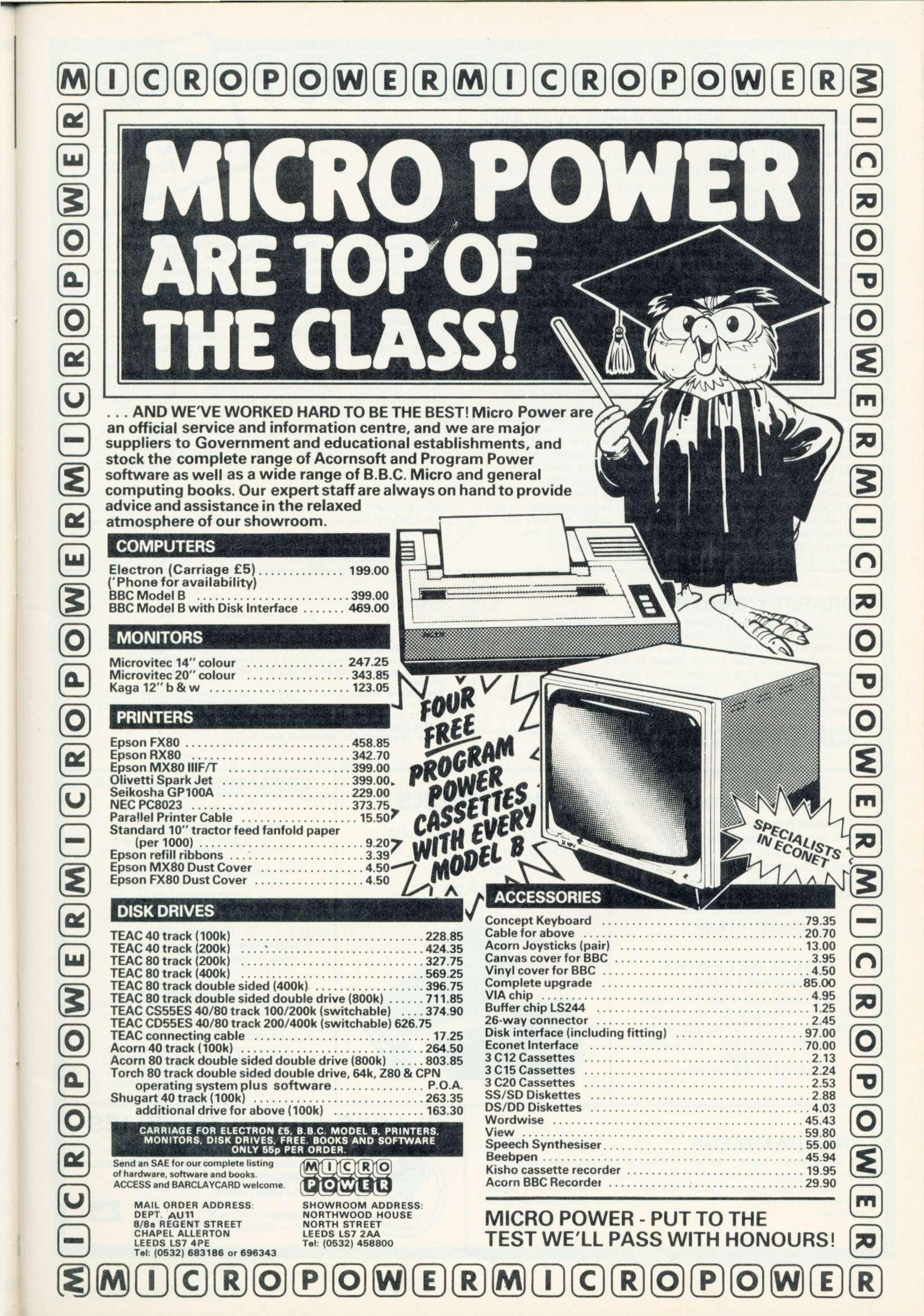
The calculation is handled by PROCprim, which is generalised to handle graphs with any number of vertices (passed in nvert%). The array u% has one element for each point in the graph. The element is set to TRUE if the item is in the MST constructed so far. Each time round the main loop (lines 670-850) one more edge is added to the MST. The method to find the shortest edge to add is in lines 720-800 and involves two loops to look at all possible edges.

This is far from efficient; it is possible to make the program far faster by a subtler method of finding the shortest edge. For a start we could keep the edges in a list (*Acorn User August*) in order of length, and just scan down until we found the first one with one end in and one end out of the tree. I have chosen the method in the program instead because it is clearer and keeps the


Figure 1


Figure 2


Figure 3



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program short. I leave it as an exercise for the reader to improve it. Having found the shortest edge, it is added to the MST.

This is not the only way of solving the problem. Kruskall's method works by building several small MSTs and linking them together. Like Prim's technique it is well described in Aho, Hopcroft and Ullman's book *Data Structures and Algorithms*, published by Addison-Wesley. This is sometimes to be preferred for large problems of this nature, such as those sometimes encountered in integrated circuit design.

In these two articles I have looked at only two of a very large number of programming techniques that use graphs. I'll come back to them in the future, but next month I'll look at how to measure the effectiveness of a particular method of solving a problem, and give examples of real-life problems that can be solved using some of the techniques I have described so far. ●

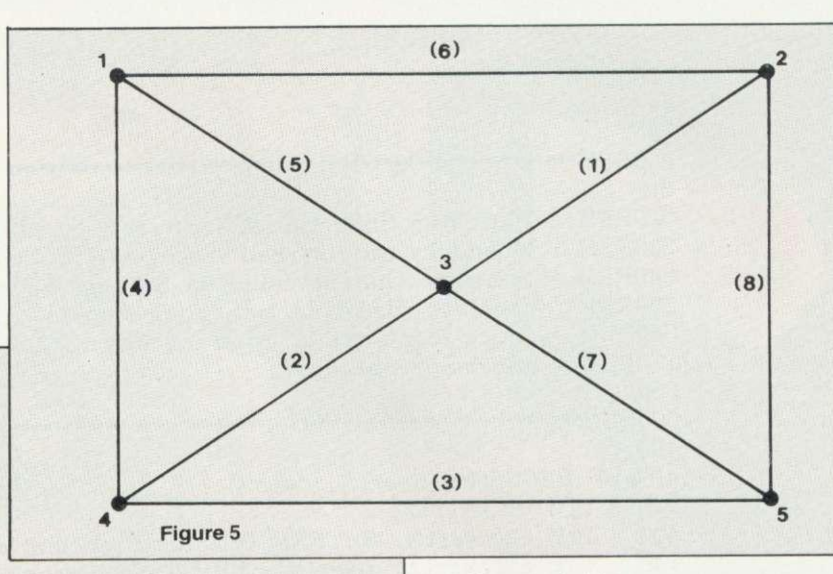
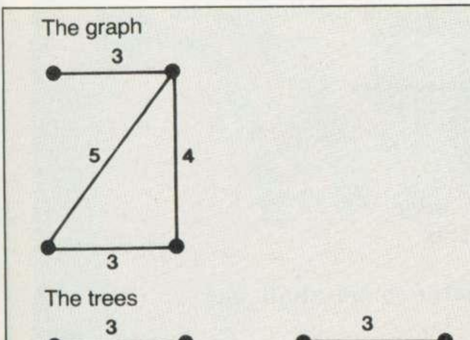


Figure 5



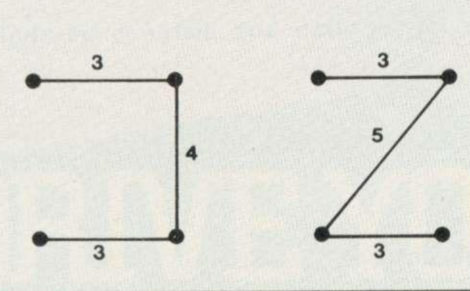


Figure 4

Listing 1. Prim's Method demonstrated

```
 10REM*********************************************************************
 20
 30REM    A program to demonstrate Prim's algorithm for finding MST's
 40
 50REM*********************************************************************
 60
 70now% = TIME
 80
 90PROCprim (5, 200)
100
110PRINT "The following edges comprise the MST:" '
120FOR i% = 2 TO 5
130   PRINT "(" ; t%(i%, 1) ; ", " ; t%(i%, 2) ; ")"
140   NEXT i%
150
160
170PRINT ' "Time taken: " ; TIME - now% ; "cs."
180END
190
200DATA 1, 2, 6
210DATA 1, 3, 5
220DATA 1, 4, 4
230DATA 2, 3, 1
240DATA 2, 5, 8
250DATA 3, 4, 2
260DATA 3, 5, 7
270DATA 4, 5, 3
280DATA 0, 0, 0
290
```

▶

```
300REM*****************************************************************
310
320REM    PROCprim finds the MST, from a graph with nvert% vertices, and
330REM    adjacency matrix read from DATA at data%. This particular version
340REM    is slower than it could be because of the simple way it finds the
350REM    shortest edge (the two inner loops). This could be replaced by a
360REM    single loop, and a different way of holding the information in the
370REM    adjacency matrix.
380
390REM*****************************************************************
400
410DEF PROCprim (nvert%, data%)
420    DIM u%(nvert%)
430    DIM t%(nvert%, 2) :REM One for each end of an edge
440    DIM c%(nvert%, nvert%) :REM The adjacency matrix
450
460    infinity% = 10000 :REM much larger than any distance we shall use
470
480    FOR i% = 1 TO nvert%
490       FOR j% = 1 TO nvert%
500          c%(i%, j%) = infinity% :REM reset the matrix
510          NEXT j%
520       NEXT i%
530
540    RESTORE data% :REM get the data
550    READ i%, j%, temp%
560    REPEAT
570       c%(i%, j%) = temp%
580       c%(j%, i%) = temp%
590       READ i%, j%, temp%
600       UNTIL i% = 0
610
620    FOR i% = 2 TO nvert% :REM Clear the table of edges in the MST
630       u%(i%) = FALSE
640       NEXT i%
650    u%(1) = TRUE :REM Just one in the tree
660
670    FOR i% = 2 TO nvert% :REM put the rest in the tree
680       lu% = -1 :REM end of shortest edge in the MST
690       lnotu% = -1 :REM end of shortest edge not in the MST
700       least% = infinity% :REM length of the shortest edge
710
720       FOR j% = 2 TO nvert% :REM possible edges not in MST
730          FOR k% = 1 TO nvert% :REM possible edges in MST
740             IF NOT (u%(k%) AND (NOT u%(j%))) THEN GOTO 790
750
760             REM the edge has one end in and one out of the MST
770
780             IF c%(j%, k%) < least% THEN
                   lu% = k% : lnotu% = j% : least% = c%(j%, k%)
790             NEXT k%
800          NEXT j%
810
820       t%(i%, 1) = lu% :REM put in the tree
830       t%(i%, 2) = lnotu%
840       u%(lnotu%) = TRUE
850       NEXT i%
860    ENDPROC
```

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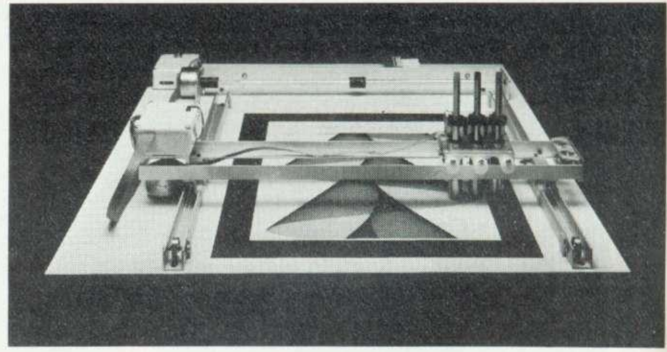
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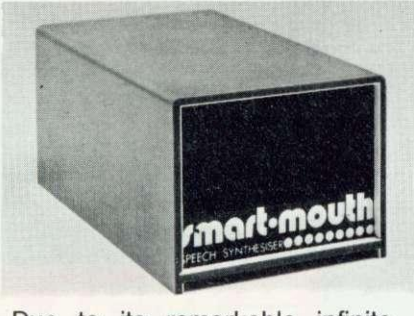
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Joe Telford outlines stacks and their influence on the BBC micro

BASIC STACKS

A 'STACK' is a data structure to which items can be added and deleted only from one end. Figure 1 shows a common stack – plates piled on top of one another. In this case the last plate on the stack must be the first one off, and the stack can only be accessed from the top. Because the number of plates is variable, the position of the top of stack varies too. If we add too many plates the stack will become unmanageable, so we must be careful to let the size of our stack of plates vary within the bounds of our stacking system.

Stacks are implemented on the BBC micro, but normally they are controlled by the operating system, and look after the sequence of returns from subroutines and procedures. To implement a stack in Basic, we turn to another data structure, a 'list'. Figure 2 shows a list of 10 items which we will call our stack.

The bottom of the stack is item 0 and the maximum size of the stack is 10 items, ie when item number nine is entered, no futher entries will fit onto the stack. This condition is called an 'overflow'. If we take items away from the stack we will eventually be left with nothing on the stack. If we still try to reduce the level of the stack, we will cause an 'underflow'. Because the top of the stack varies up and down between 0 and 9, we need to know where the top is at any time. To do this we use a 'pointer' which contains the item number of the last addition to the stack.

Applications of stacks include stack-based computer languages such as Forth (available for the BBC micro) as well as mathematical applications using Reverse Polish Notation. RPN is particularly interesting as it forms the basis of number manipulation techniques used in Forth. Because it can be easily applied to stacks, RPN calculations are very fast.

Our normal technique of handling arithmetic is to scan from left to right across an expression and handle operators in order of importance, for example multiplication has precedence over addition so that in the example:

2 + 3 * 7 – 3

We perform 3 * 7 = 21 before the other items, giving us 2 + 21 – 3 which we add from left to right to give a final answer of 20. In RPN we start with a stack content of 0, so the same expression would look like:

0) 2 + 3 * 7 – 3

Where the 0 is already on stack.

The sequence of operations is strictly from left to right and each operation refers to the two items at the current top of stack.

1. 2 is placed on the stack.
2. + causes 2 + 0 = 2 (left on stack).
3. 3 is put on the stack.
4. * causes 2 * 3 = 6 (left on stack).
5. 7 is put on the stack.
6. – causes 6 – 7 = – 1 (left on stack).
7. 3 is put on the stack.

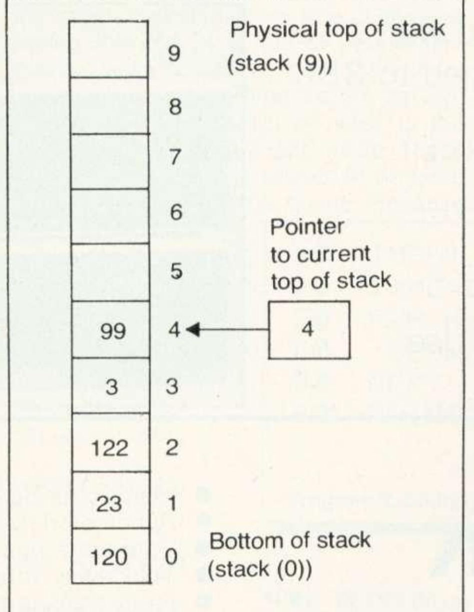


Figure 2. A list as a stack

Nothing happens now because there is no operator after the 3. RPN will go no futher with the calculation. Figure 3 demonstrates the condition of the stack at each stage.

It is valuable to be able to demonstrate the use of stacks with examples, because this prepares us for learning Forth-type languages. Because of the structures of BBC Basic, we can implement a simple stack. As our implementation is graphic in nature, we will call it a stack simulation. Program 1 contains the complete stack simulator.

Type the program in and run it. A Plate Well appears in which the number 0 is item 0 on the stack. The word INPUT >> invites us to type either a number, or an operator selected from '+–*/'. Numbers will be added on to the stack while operators will combine the top two numbers and leave only their result on the stack. Errors are trapped within the program and reported to the user. The program also demonstrates the accuracy of the micro, particularly with small numbers. The escape key will conclude the program.

The body of the program is made up of the two lines 10 and 20. They call the 'setup' procedure, then repeatedly call the 'input' procedure.

PROCsetup clears the screen, prints the title, dimensions space for the stack (list) then draws the plate well. It sets the pointer to location 0 of the stack, and initialises this stack item to contain 0. It calls the 'printstack' procedure.

PROCprintstack erases the stack on the screen and prints out the values of the stack contents, provided they exist (ie they are not " "). It also prints the stack pointer to the right of the plate well.

PROCinput prints the input prompt, and waits for any input other than just the return key. It clears the error line, then checks to see if an operator has been input. If one has, it calls the 'operator' procedure. If not, it checks for a number. If a number has been input it calls the 'onstack' procedure.

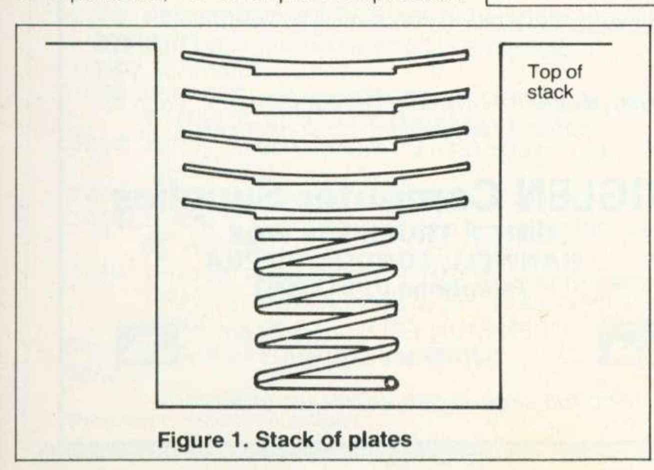


Figure 1. Stack of plates

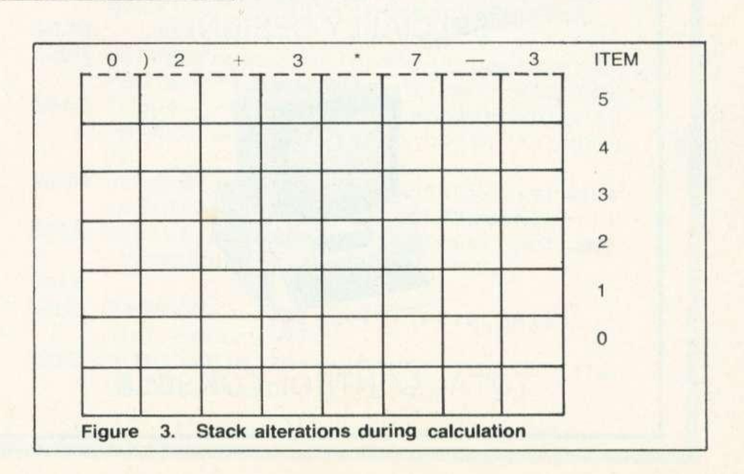
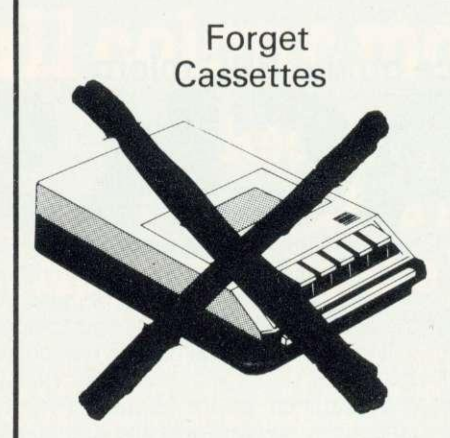


Figure 3. Stack alterations during calculation

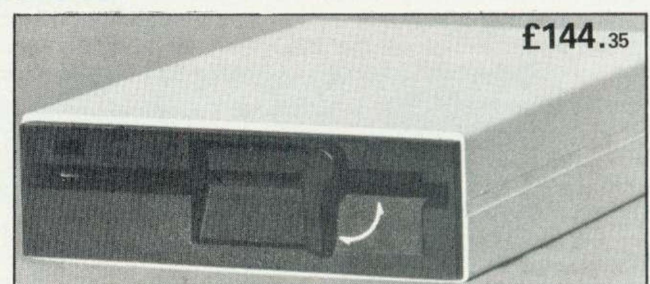


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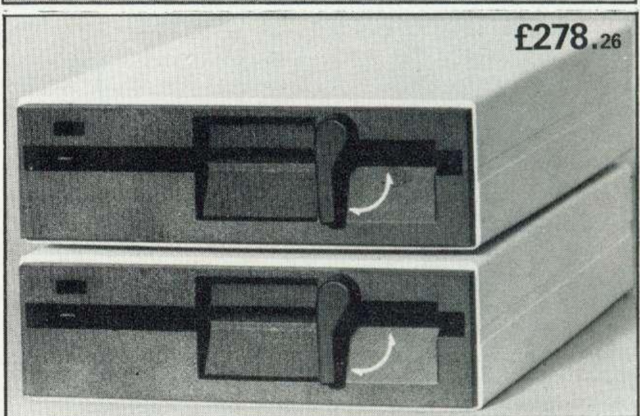


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If an illegal character has been entered, it calls the 'err' procedure.

PROConstack checks for an overflow, which would occur if the pointer is at item nine. If an overflow occurs, it calls the 'err' procedure. If not, the pointer is incremented and the number entered is stored at the new top of stack.

PROCoperator checks for an underflow which would occur if the pointer is at item 0. If this occurs the 'err' procedure is called. If not, the top two items are combined according to the operator entered. The top stack item is then deleted, the pointer decremented, and the result is placed in the new top of stack.

PROCerr is used to print error messages at the bottom of the screen. It emits a 'beep' to alert the user to errors.

Although the 'input' procedure governs much of what goes on in the simulator, it is the 'operator' procedure which controls the stack. If we make new commands legal by adding them to the INSTR of line 3010, they will be passed through to the 'operator' procedure. A particularly useful extra comand might be 'POP' as in 'pop the top item off the stack'. To achieve this command, we rewrite line 3010 to say:

```
3010INPUT TAB(8,15);" "in$:
  UNTILin$>" ":A=INSTR("+-*/P",in$)
```

Then we must alter the 'operator' procedure to match.

```
5020IFop$<>"P"stack$(pointer-1)
  =STR$(
EVAL(stack$(pointer-1)+op$+stack$
  (pointer)))
```

Running the program now results in our losing the top item from the stack whenever we type 'P'

There are several problems for you to attempt:

- increase the size of stack up to 20 items;
- alter the 'printstack' routine to account for this;
- alter the 'setup' routine to draw the new plate well to match the first two problems;
- a stack-based language has the word SWAP as part of its vocabulary. SWAP causes the top two items on the stack to be swapped. Alter the simulator to handle 'S' in this context;
- this same language has the word DUP which causes the top item of the stack to be duplicated as the new top of stack, and the pointer incremented to match. Add this facility to the simulator;
- the language has another word ROT which moves the top stack item down one place, the second top item is also moved down one place and the third top item is brought to the top. Add a ROT facility to your stack.

Now let's move on to queues. Most of you will have queued at some time. It involves joining the end of a line of people and moving forward until we reach the front of the queue, at which time we are served. Program 2 sends a list of notes to the sound generator of the BBC micro. These notes are sounded in sequence as each reaches the front of the queue. Because the BBC micro can handle a short queue in its sound buffer, control is returned to the user before the notes finish sounding. The purpose of the TIME=0 and the PRINT TIME lines is to show how long it takes the different numbers of notes to enter the sound queue.

Notes entered	Time(secs) to finish program
1	0.01
3	0.02
6	0.03
7	1.01
8	2.01
9	3.01

Figure 4. Results for sound queuing

Try running the program several times entering numbers from 1 to 10. Figure 4 is the sort of table which can be produced. The table indicates that the BBC micro can play one note, and queue a further five notes per voice without slowing down a Basic program. When the program tries to add a seventh note, this must wait until the first one is finished so it can join the queue. In our program, this takes a whole second.

Look at figures 5a and b which show a queue in action. In computer terms, a queue consists of a list to which information is added at one end (called the tail) and another end from which information can be released, called the head.

Now, the BBC micro contains a number of buffers, which can be regarded as

```
10  INPUT "number of notes? "no
20  TIME=0
30  FOR note= 1 TO no
40   SOUND1,-15,note*10,20
50  NEXT
60  PRINTTIME
```

Program 2. Sound queuing

```
  10 MODE4:PROCsetup
  20 REPEAT PROCinput:UNTIL FALSE
  30
1000 DEFPROCsetup:CLS:PRINTTAB(10,2)"St
     ack Demonstration" :DIMstack$(9)
1010 MOVE0,480:DRAW448,480:DRAW448,150:
     DRAW960,150 :DRAW960,480:DRAW1280,
     480
1020 pointer=0:stack$(0)="0":PROCprints
     tack:ENDPROC
1030
2000 DEFPROCprintstack:FORI%=0 TO9:PRIN
     TTAB(15,26-I%);
2010 PRINTSTRING$(15," "):IFstack$(I%)<
     >"" PRINTTAB(15,26-I%)VAL(stack$(I
     %))
2020 PRINTTAB(31,26-I%)" ":NEXT:PRINTTA
     B(31,26-pointer)"{" :ENDPROC
2030
3000 DEFPROCinput:REPEAT:PRINTTAB(0,15)
     ;"INPUT >>" ;STRING$(31," ")
3010 INPUT TAB(8,15)" "in$:UNTIL in$>""
     :A=INSTR("+-*/",in$)
3020 PRINTTAB(0,30);STRING$(39," ")
3030 IFA>0 PROCoperator(in$):ENDPROC EL
     SE no=VAL(in$)
3040 IFno=0 AND INSTR(in$,"0")=0PROCerr
     ("Entry not numeric or {+*/-}"):EN
     DPROC
3050 PROConstack(no):ENDPROC
3060
4000 DEFPROConstack(no):IF pointer=9 PR
     OCerr("stack overflow"):ENDPROC
4010 pointer=pointer+1:stack$(pointer)=
     STR$(no) :PROCprintstack:ENDPROC
4020
5000 DEFPROCoperator(op$):IF pointer=0
     PROCerr("stack underflow"):ENDPROC
5010 IFop$="/" AND VAL(stack$(pointer))
     =0 PROCerr("Division by 0 "):ENDPR
     OC
5020 stack$(pointer-1)=STR$(EVAL(stack$
     (pointer-1) +op$+stack$(pointer)))
5030 stack$(pointer)="":pointer=pointer
     -1:PROCprintstack :ENDPROC
5040
6000 DEFPROCerr(X$):PRINTTAB(0,28);"Cur
     rent Error:-"
6020 PRINTTAB(0,30);STRING$(39," ");TAB
     (0,30);X$:VDU7 :ENDPROC
```

Program 1. Stack simulation

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queuing structures, the one used most often is the keyboard buffer. Here the first character generated by the keyboard enters the queue first and leaves it first. For this reason a queue is called a FIFO (first in first out) structure. Other examples of queues are the RS423 input/output buffers and the printer buffer.

The BBC micro has been designed around interrupts to protect the buffers from overflow and hence losing characters. The major problem is not so much the loss of information, but the garbage which can enter a buffer. It may become imperative to clear a buffer, so the head of the queue in that particular buffer is placed at the beginning of the buffer, and the next important piece of information can be swiftly used. To do this there are a number of buffer clearing commands (figure 6).

With the discussion above related to the use of queues as data structures, this is a pertinent place to discuss queuing in the outside world. Many services, for example banks, supermarkets and post offices use queues to order people, rather than data. Although the inevitable queues are tedious for people, the business must carefully monitor them so customers are not lost, and there will be a trade-off between speed of service and cost of staffing. The BBC micro can prove a useful aid in predicting queue sizes, and lost custom, simply by simulating, in seconds, the queues which a business may expect over a day or a week.

What follows cannot be an in-depth treatise on queues, but our simulation examines a building society which maintains a single queue up to a series of cashiers. The head of the queue can be served at any vacant position. Program 3 is the queue simulation program.

The queue itself has three main attributes: people enter it at a particular rate, eg 20 per hour; people leave it at a particular rate depending on the serving rate of the cashiers, eg six per hour per cashier; when the queue is full, customers will not wait outside, and so custom is lost.

The simulation will produce a detailed report every so often showing the state of the queue, and the customers served or lost (figure 7).

The program is based on random numbers. Because a number of people enter the bank in an hour, we can say (in this simple simulation) that the probability of a person entering the bank in any one minute is roughly the hourly rate divided by 60 (custom/60 in line 220). Similarly, the exit rate per cashier is given as a number of customers per hour. Again we can say that the probability of a person being seved in any one minute is roughly the hourly rate divided by 60 (serve/60 in line 230). Once we have this probability we can apply it to the result of a random number, if the first random number is less than the entry probability then we add a person to the queue. If any cashier's random number is less than the exit probability then we re-

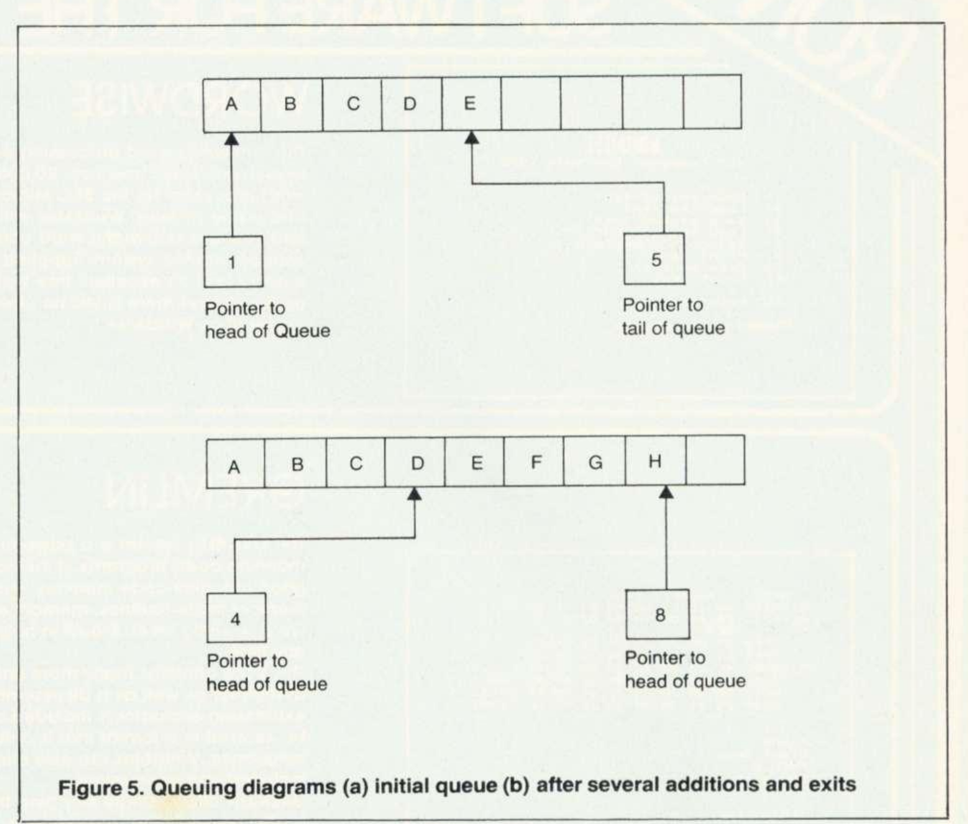


Figure 5. Queuing diagrams (a) initial queue (b) after several additions and exits

*FX21,0	Keyboard	*FX21,5	Sound channel 1
*FX21,1	RS423 input	*FX21,6	Sound channel 2
*FX21,2	RS423 output	*FX21,7	Sound channel 3
*FX21,3	Printer	*FX21,8	Speech synthesis
*FX21,4	Sound channel 0	*FX15,0	All buffers
		*FX15,1	Current buffer

Figure 6. Commands which flush buffers

```
Max queue length? 8
Start queue length? 0
How many hours open? 3
Customers entering per hour? 36
How many cashiers? 3
How many customers can
1 cashier serve per hour? 12
How long between reports? (mins) 15
***START***
Served:     7 Qing:    2 lost     0
Served:    16 Qing:    1 lost     0
Served:    24 Qing:    0 lost     0
Served:    30 Qing:    6 lost     0
   1Hr/s--------------------
Served:    37 Qing:    7 lost     3
Served:    45 Qing:    7 lost     3
Served:    56 Qing:    2 lost     3
Served:    63 Qing:    2 lost     3
   2Hr/s--------------------
Served:    71 Qing:    0 lost     3
Served:    78 Qing:    3 lost     3
Served:    87 Qing:    4 lost     3
Served:    97 Qing:    0 lost     3
   3Hr/s--------------------
```

Figure 7. Possible printout from queue simulation

move a customer from that cashier.

A problem can occur when either rate is equal to or greater than 60 customers per hour. This means that in our simple simulation we would have a certainty every minute, and the value of the random numbers would be lost. In this instance it is best to work on the probability of a person entering or leaving each second, and to adjust queue lengths every second, rather than every minute. This would mean adjusting lines 220 and 230 to divide by 3600 rather then by 60.

The main body of the program runs from line 10 to line 90. First it calls the 'setup' procedure, then it produces an accelerated day by which each loop round lines 40, 50 and 60 represents a minute in the business. Every 'minute', the 'transact' procedure is called. At the end of every report cycle, the results are printed by the procedure called at line 70. This format of transactions and results continues until the end of the set time, tested in line 80.

The 'setup' procedure creates the initial variables which the program uses and creates a list of cashiers, identified by number. A 0 shows a particular cashier is free, a 1 that the cashier is serving. Initially the cashiers are all free.

The 'transact' procedure deals with the cashiers first, by bringing a person from the queue to any free cashier (line 330) then by checking to see if a cashier has finished serving and freeing that cashier for the next person in the queue (line 340). Because there may be a large number of cashiers we loop around them between lines 320 and 350.

The next task of the 'transact' routine is to check for a customer joining the queue (line 360). If the queue is full the customer goes away (line 370), which also totals the 'lost customers'. The use of the 'flag' variable keeps track of the need to add a person to the total served.

The 'results' procedure simply prints the customers served, those queuing, and the total lost customers to date. Every hour that passes is indicated by line 430.

Further problems

1. Alter the queue simulation to handle rates of customers greater than 60 per hour.
2. Consider a queue at traffic lights. Write a short simulator to account for traffic entering a queue and leaving it. The traffic should enter the queue constantly, but may only leave it when the light is green, so the period of the lights needs to be taken into account.
3. Another queue at a road junction has one queue of cars turning left on to the major road, and another queue turning right. Cars may enter either queue at a particular rate, but the exit rate of each queue depends of the frequency of gaps in one or both lanes of traffic on the major road. Write a program to simulate these queues.

```
10 MODE3
20 PROCsetup
30 REPEAT
40  FOR mins = 1 TO cycle
50   PROCtransact
60  NEXT
70  PROCresults
80 UNTIL time>=day
90 END
100 DEFPROCsetup
110 INPUT''"Max queue length? "max
120 INPUT"Start queue length? "queue
130 INPUT"How many hours open? "hours
140 INPUT"Customers entering per hour? "custom
150 INPUT"How many cashiers? "cashiers
160 PRINT"How many customers can"
170 INPUT"1 cashier serve per hour? "serve
180 INPUT"How long between reports? (mins) "cycle
190 day=hours*60
200 lost=0:total=queue
210 time=0:@%=4
220 custom=custom/60
230 serve=serve/60
240 DIMcashier(cashiers)
250 LOCALI%
260 FORI%=1 TO cashiers
270  cashier(I%)=0
280 NEXT
290 PRINT"***START***"
300 ENDPROC
310 DEFPROCtransact
315 LOCALI%,flag
320 FORI%=1 TO cashiers
330  IFcashier(I%)=0 AND queue>0 cashier(I%)=1:queue=queue-1
340  IF RND(1)<serve ANDcashier(I%)=1 cashier(I%)=0
350 NEXT
360 IF RND(1)<custom queue=queue+1:flag=1
370 IF queue>max queue=queue-1:lost=lost+1:flag=0
380 IF flag=1 total=total+1
390 time=time+1
400 ENDPROC
410 DEFPROCresults
420 PRINT"Served: "total-queue" Qing:"queue" lost "lost
430 IFtime  MOD60=0  PRINTtime DIV 60;"Hr/s"; STRING$(21,"-")
440 ENDPROC
```

Program 3. Queue simulation

EXPERIMENTS IN MODE 7 BY MARTIN PHILLIPS

THIS problem page is a new, regular feature of *Acorn User* presented by Martin Phillips. It will present simple hints and tips and answer readers' queries about the Electron, BBC micro and BBC Basic. £5 will be paid for a 'star' letter, so you can profit from your problem!

If you have a query concerning some aspect of programming or some technical difficulty, please give sufficient information and make your question specific. The following query was received recently:

'I am in the middle of writing a program for an exam project on my 32k BBC. However, although the program is only just over 21k long, when it is run the computer prints up the error message 'No room' or 'Dim space'. I would be grateful if you could tell me any methods of running the program successfully without the need to cut the program up.'

Now, there are any number of reasons why a program will run out of memory. Without knowing far more about the program, the style of programming and techniques used, and whether discs Econet have been fitted, it is impossible to give anything but general hints on memory saving. It also helps to know the operating system and Basic.

So please bear these points in mind and include a listing if possible. Unfortunately, we cannot reply to letters individually, and are unable to return letters, listings, etc. Send you letters to: Hints & Tips, Acorn User, 53 Bedford Square, London WC1B 3DZ.

TELETEXT CHARACTERS

SEVERAL letters have been received from readers who have tried using teletext characters in mode 7 but been unable to get them to work.

Mode 7 coloured text is well worth experimenting with, as eight colours are available on the screen at once and the screen memory uses only 1k. It also has a clear print style with the advantages of double-height characters, coloured backgrounds and flashing letters.

Figure 1 shows how the screen is divided up in mode 7, teletext mode. There are 1,000 pixel blocks into which a number, letter, graphics character or control code can be inserted. A list of the displayed alphanumeric characters appears on pages 486-487 of the *User Guide*, and the displayed graphics characters appear on the next two pages. Each character has its own ASCII code, which is shown on the charts in the *User Guide*.

Codes 0 to 31 are the normal control codes that operate in any mode, but codes 128 to 159 are the special teletext codes. To use them they must be printed in one of the screen pixel blocks in the same way as a normal character. In the same way, too, they take up one pixel space, although a blank space appears on the screen.

To see how they function, we need some text on the screen to work with. Program 1 (overleaf) gives three lines of text. Line 10 ensures that mode 7 is selected and clears the screen too. Lines 20-40 print the same message on lines 5, 6 and 7, starting at the left-hand edge of the screen. Now add a new line 50 and rerun the program:

```
50 PRINT TAB(0,6)CHR$130' '
```

The middle line of text should now appear in green. CHR$130 is the code for green alphanumeric print; the two apostrophes are there to move the cursor down two lines so that it does not interfere with the printing on the screen.

Having run this, there are several points to note. First, only the middle line has appeared in green, showing that the control code affects only the horizontal line in which it is placed. Second, the first letter of the middle line has been replaced by a space. This is because the capital 'T' has been overwritten by the control code. To work correctly the control code needs to be inserted in an existing space between words or at the start of the line. Change line 50 to read:

```
50 PRINT TAB(11,6)CHR$130' '
```

Now only part of the line turns green instead of the whole line. The control code has been inserted in the space between the 1 and the rest of the line and so has not deleted any text. Now we can elaborate on one of the above points. Only print on the same line and after the control code will be affected by that control code. Instead of CHR$130 in line 50, try the following codes:

```
CHR$133   Magenta print
CHR$129   Red print
CHR$136   Flashing print
```

There are several ways these codes can be included in programs.

- Use CHR$ as we have seen above.
- Use a VDU statement instead, eg, VDU 130 for green lettering.
- Include in a string, eg A$=CHR$130+"Hello".
- Put the control code directly into the string, using the user-defined keys. To select green, press SHIFT at the same time as f2.

Although little used this latter method is the easiest to use, mostly because it cannot be shown in listings as the codes are not printed out. Control characters so produced must be put inside speech marks. They will appear in colour in listings as well, but again only on the line in which they are printed. This facility of the user-defined keys is available only with the 1.2 operating system and doesn't work with the 0.1 OS.

To help remember which keys do what, I have included a full-sized slip (figure 2, overleaf) which can be cut out or copied and placed under the plastic strip above the user-defined keys. You will see that by using these keys in conjunction with the CTRL key all the teletext graphics symbols can be drawn. I'll have more to say about this next month.

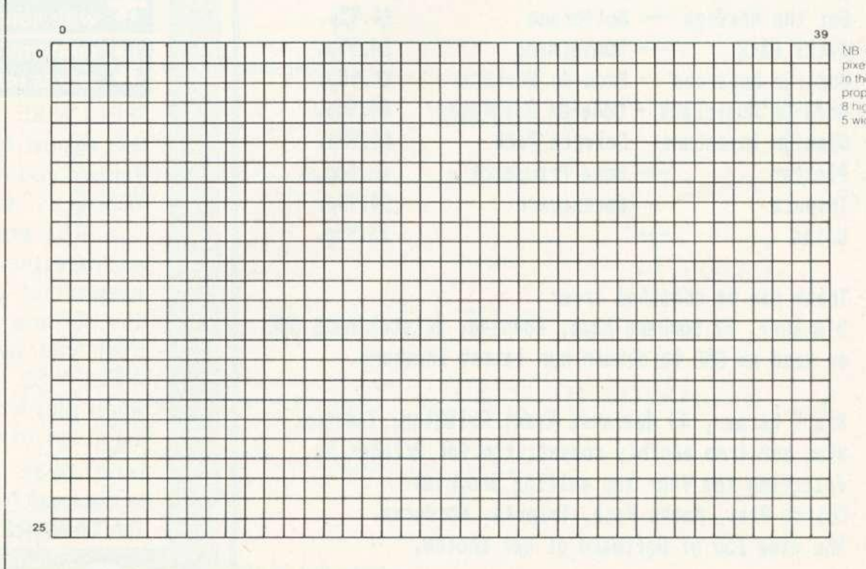


Figure 1. Mode 7 screen display grid

```
10 MODE 7
20 PRINT TAB(0,5)"THIS IS ONE LINE OF TEXT ON THE SCREEN"
30 PRINT TAB(0,6)"THIS IS ONE LINE OF TEXT ON THE SCREEN"
40 PRINT TAB(0,7)"THIS IS ONE LINE OF TEXT ON THE SCREEN"
```

Program 1. Three lines of text to work with

CTRL (Graphics)		red	green	yellow	blue	magenta	cyan	white	Conceal	Contiguous
SHIFT		red	green	yellow	blue	magenta	cyan	white	Flash	Steady

Figure 2. User-defined key slip (1.2 OS)

TILES ON A COLOUR GROUND

MR BAXTER of Bristol has seen several programs with double-height titles on a coloured background in mode 7 and would like to know how they are done.

This requires the use of the CHR$141 control code to give the double-height lettering. Code 157, which gives a coloured background, is also needed. The colour has to be defined in a previous pixel on the same line.

Two programs are presented here in procedure form (programs 2 and 3) to show the technique. They could be saved and used in your own programs. They are similar, except that one gives a background just wider than the title length (program 2) and the other gives a full line background (program 3). Both procedures will centre the title, which must be shorter than 32 characters and spaces to fit on the line correctly.

Each procedure is called up using four parameters: the line-number for the title (counting from the top); the background colour; the foreground colour; and the title itself, either given directly in speechmarks or as a string variable. The colour numbers are numbered in the normal way for COLOUR and GCOL statements, except that it is not possible to select black using 0. For example

1 red
2 green
3 yellow
4 blue
5 magenta
6 cyan
7 white

```
10 MODE7
20 PROCtitle(2,1,4,"MY TITLE")
30 END
40
100 DEFPROCtitle(vertpos,backcol,forecol,word$)
110 REM Double height title
120 REM Background is width of title
130 X=(32-LEN(word$))/2
140 FOR N=0 TO 1
150 PRINTTAB(X,vertpos+N)CHR$141 CHR$(128+backcol);
160 PRINT CHR$157 CHR$(128+forecol) word$
170 PRINTTAB((38-X),(vertpos+N))CHR$156
180 NEXT N
190 ENDPROC
```

Program 2. Colour background wider than title

```
10 MODE7
20 PROCtitle(2,1,4,"MY TITLE")
30 END
40
100 DEFPROCtitle(vertpos,backcol,forecol,word$)
110 REM Double height title
120 REM Background is full screen width
130 X=(40-LEN(word$))/2
140 FOR N=0 TO 1
150 PRINTTAB(0,vertpos+N)CHR$141 CHR$(128+backcol);
160 PRINT CHR$157 CHR$(128+forecol)
170 PRINTTAB(X,vertpos+N) word$
180 PRINTTAB(38,vertpos+N)CHR$156
190 NEXT N
200 ENDPROC
```

Program 3. Background to full width

£5 BUILD-UP TO DOUBLE HEIGHT

THIS month's £5 star letter is from Mr Willgoss of Pocklington, Humberside, who poses a seemingly simple problem. He would like to be able to input an entry into the computer in mode 7 using double-height lettering.

The double-height lettering facility in mode 7 requires the use of teletext character code 141. In order to get the double-height lettering to work correctly you have to print the control code 141 followed by the lettering on each of two successive lines. Try the following line and run it to see the effect:

```
10 PRINT CHR$(141) "HELLO"
```

It will print only the top half of the word "HELLO". To print out the whole word, the same line must be entered again:

```
20 PRINT CHR$(141) "HELLO"
```

Now when the program is run, it will magically print out the word "HELLO" in double height and not, as one would expect, two top halves of the word. Once the control code has been written into a line (a blank space will appear on the screen where the code resides), the rest of that line will appear in double-height lettering.

It seems a simple job similarly to program in an INPUT statement. Program 4 shows just such an attempt – and it does not work. It prints out the top half of "NAME PLEASE", and then prints out the top half of the name as it is entered. Once the name has been entered it then goes to line 20, printing out the bottom half of "NAME PLEASE", and waits again for a name to be entered.

The problem occurs in the use of the INPUT statement, but all is not lost. Instead you can make use of the versatile GET statement to input a simple numeric variable. If GET$ is used, a string variable can be input.

The following short program illustrates its operation.

```
A$=GET$:PRINT A$
```

Unlike the INPUT statement, the GET$ statement does not print out the letter as it is keyed in. This has to be done using a print statement and the letter can then be printed double-height.

To input a whole string of letters a loop has to be made, with a test to see whether RETURN has been entered – this will stop the loop. A REPEAT. . .UNTIL loop is the ideal one to use here. Program 5 shows one way the routine could be made to work. It is not terribly elegant, and program 6 shows a longer but more elegant way of achieving the same input. Program 6 has the advantage that, once defined, the procedure to print double-height can be called up at any time to print anywhere on the screen. (The three parameters following the PROCdouble statement at line 30 give the horizontal and vertical screen positions, as given in figure 1, together with the string to be printed.)

Although longer in this short example, this approach proves quicker and easier in a longer program if use of the double-height procedure is made several times during the course of the program. In both programs the string assigned to the name, name$, is set to a null string (a string zero characters long) at line 20.

Although not essential in the programs presented here, it is good practice to do this as on some occasions each name will be added into the variable to give one long string of names if a program is run several times.

```
10 MODE 7
20 PRINT CHR$(141);:INPUT"NAME PLEASE "name$
30 PRINT CHR$(141);:INPUT"NAME PLEASE "name$
```

Program 4. Problem with double-height characters

```
10 MODE 7
20 name$=""
30 PRINTTAB(0,2)CHR$141"NAME PLEASE"
40 PRINTTAB(0,3)CHR$141"NAME PLEASE"
50 REPEAT
60 name$=name$+GET$
70 PRINTTAB(14,2)name$
80 PRINTTAB(14,3)name$
90 UNTIL RIGHT$(name$,1)=CHR$(13)
00 PRINTTAB(0,6)"HELLO "name$
```

Program 5. Inelegant solution

```
10 MODE 7
20 name$=""
30 PROCdouble(0,2,"NAME PLEASE")
40 REPEAT
50 name$=name$+GET$
60 PROCdouble(14,2,name$)
70 UNTIL RIGHT$(name$,1)=CHR$(13)
80 PRINTTAB(0,6)"HELLO "name$
90 END
100
110 DEFPROCdouble(horpos,vertpos,word$)
120 FOR N=0 TO 1
130 PRINTTAB(horpos,vertpos+N)CHR$(141) word$
140 NEXT N
150 ENDPROC
```

Program 6. Double-height characters anywhere on the screen

FLIP SLIPS

■ Programs are now being made which incorporate the use of the user-defined function keys. A slip of paper indicating the key definitions is supplied with each to go under the clear plastic strip, but these can soon be mislaid or get damaged. Here's a way to keep them all together, ready for use in flip-over book form. Find an old calendar (not too difficult at this time of year) at least 20cm wide with a spiral binding. Cut most of the paper off parallel to the binding 5cm below it and, if necessary, cut it widthways to about 20cm long. The bottom sheet can then be inserted under the plastic strip to hold the leaves in position and the key definitions can be glued to each page. Now all the pages can be kept together and be available when wanted simply by flipping them over. For extra protection, cover the pages with transparent book-binding film.

■ If using the same series of teletext control codes more than once in a program, put them into a string variable at the start of the program and then call up the variable each time:

```
A$=CHR$133+CHR$157+CHR$136+
CHR$133
```

When printed, A$ will give a magenta background and any text then printed will flash blue.

SPEAK TO ME

Limitations on the vocabulary of the BBC micro's speech chip can be overcome using some simple assembly language routines provided by Ian Rowlings

MUCH has been said about the BBC Voice Synthesiser, but as yet it hasn't had a lot to say for itself. The vocabulary of the word PHROM supplied by Acorn is quite comprehensive and includes a number of prefixes and suffixes with which to construct additional words. Unfortunately, 165 words has its limitations. You start thinking 'if only Acorn had included this word, or that prefix'. They do intend to extend the vocabulary. The article in the October 1982 issue gave a clue as to what is available; now it's time for the nitty gritty. Let's pull the speech processor and the word PHROM apart and see what can be done – with a little imagination you will be able to get your BBC to say almost anything.

First, a summary of the more basic methods of accessing the vocabulary, with apologies to those already familiar. The simplest is to use the Basic sound command with the channel set to −1 and the second parameter set to a given variable. This variable can be a 'word number' in the range 32 to 291 and these provide the full range of the standard vocabulary, including the part words. For example, SOUND−1,65,0,0 will produce the letter 'A'. The last two parameters are always zero. The lower range 32 to 126, which corresponds to the ASCII code range, will produce sounds wherever possible that associate with the ASCII character. This provides a second format, for example, SOUND−1,ASC"A",0,0. The sounds in the lower range are duplicated in the range 127 to 291, so SOUND−1,159,0,0 will also produce the letter 'A'. The reason for this is that the upper range provides a method of directly accessing words in the PHROM by location. We will look at this shortly.

One of the simplest methods of constructing words is to use the part words provided, and stringing several sound commands together. SOUND−1,207,0,0: SOUND−1,264,0,0:SOUND−1,131,0,0 for example, will produce the word 'in- ten -d'. This provides a very useful method of construction, but again one with limitations. To be able to construct almost any word we must be able to obtain an almost unlimited number of part words, and the only way of obtaining these is to pull existing words apart. To do this we must first look closer at the sound parameters.

So far we have considered the first parameter of the sound command to be −1. From now on we must consider the value of this in its hex equivalent, &FFFF. In this two-byte format, it is used to tell the speech processor exactly what to do with the rest of the sound parameters. The first byte (MSB) is always &FF, but the second (LSB) can take several values. Consider the value &FFFx, where 'x' relates to the word PHROM number. This nibble (four bits) can take the value 0 to 15 (&F), and thus in future up to 16 different PHROMs could be addressed. For our purposes the standard on-board PHROM is number 15, hence &FFF(F), which means 'speak from the on-board PHROM using the word number provided'. To access words directly from the PHROM, and for the purpose of constructing our own words, we must tell the processor to use 'absolute addressing'. This is done using the parameter &FFBx. Hence, &FFBF means 'speak using absolute addressing from the on-board PHROM'. Two additional commands, &FF60 and &FF00 are available, but we will look at these later.

Absolute addressing is just another method of accessing the vocabulary where instead of giving the second sound parameter a word number or an ASCII character, you give the start address in hex of where the data for a particular word is located in the PHROM. Thus the command SOUND&FFBF,&B5D,0,0 will access the data at the address specified and produce the sound 'A'. All the word numbers, ASCII equivalents and addresses are specified in the voice synthesis manual.

To recap, all the following commands produce the sound of the letter 'A':

```
SOUND−1,65,0,0
SOUND−1,159,0,0
SOUND−1,ASC"A",0,0
SOUND&FFBF,&B5D,0,0
SOUND&FFFF,65,0,0
SOUND&FFFF,159,0,0
SOUND&FFFF,ASC"A",0,0
```

Straightforward so far, but to continue our quest we must now look at addressing the processor in assembly language. For those who only use Basic or who have a dread of assembly language don't be put off. As you will see it's very easy, and even if you don't entirely understand it, you can still use the routines. The standard OSWORD call (*User Guide* p461), can be used with A=&07, as you would with normal sounds. First you need to set up the data block to pass the speech parameters as in figure 1.

The command type as discussed earlier should be &FF when using word numbers, and &BF when using absolute addressing. For simplicity let us put these values into zero page using pling (!) indirection. Program 1 shows how this could be done. Of course, there are several alternatives to this routine. You could extend it by placing the CALL in a loop and reading the data values required, or even passing the data as CALL parameters. Unfortunately, OSWORD merely provides an equivalent call to the Basic sound command and is not suitable for our purposes. To construct our own words we need to read and write directly to the speech processor, and the only way to do this is to use OSBYTE.

Now we can get down to some examples. There are two methods of constructing words using OSBYTE. You can if you

Address	*Contents*	
XY	Parameter 1 (LSB)	Command type
XY+1	Parameter 1 (MSB)	&FF
XY+2	Parameter 2 (LSB)	Word number or Address – low byte
XY+3	Parameter 2 (MSB)	Word number or Address – high byte
XY+4	Parameter 3 (LSB)	&00
XY+5	Parameter 3 (MSB)	&00
XY+6	Parameter 4 (LSB)	&00
XY+7	Parameter 4 (MSB)	&00

Figure 1. Data block to pass speak parameters



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wish, by constructing and passing the right data, create new words from scratch. This is, however, extremely difficult, takes a long time and consumes a considerable amount of memory. I will touch on this later. A much simpler method would be to create numerous part words which when strung together produce the desired effect. This can be done by instructing the processor to access a word from the standard vocabulary and then, after a suitably short delay, issuing a second instruction to 'chop' the word before its completion. Unfortunately, because of the way in which the word data is stored, trying to access the middle of a word with an intermediate address will only produce garbage. Only the absolute address can be used, which limits us to the beginnings of words. Still, I have found it is possible to construct complex words and sentences in this manner.

The relevant OSBYTE calls are not listed in the *User Guide*, so it's down to brass tacks. With A=&9E or A=&9F we can read or write directly to the speech processor. In either state the relevant commands are placed in Y before calling OSBYTE. At the moment we only need to write commands, and the operations to do so are:

Command	Operation
&4x	Load address
&50	Speak (from PHROM)
&70	Reset (chop!)

The 'x' in the load address command represents a nibble of the address of the word we wish to use. Unfortunately, this command also needs to include the PHROM number. So to pass both the word address and the PHROM number, this particular call has to be made five successive times. Acorn has confirmed that the information to do this in the manual is incorrect, which doesn't help much as the method could be confusing. To work out the format required involves some simple binary arithmetic and is easy. Let us consider the word 'pence' whose absolute address is &2B58. It must be represented in a somewhat unconventional manner; least significant nibble (left) to most significant nibble (right). To this is added the PHROM number – 1111 (&F). Figure 2 shows how it's done.

As you see from the result in figure 2, the value is &85BE3. In fact, it is even more simple than it appears. The first three values will always be the absolute address in reverse order, and the last value will always be &03. With a four-digit address, the fourth value will be the first digit of the address + &0C. A three-digit address is the easiest; reverse its order and tack &C3 on the end. We only need to add &40 to each digit and we have our five parameters, &48 &45 &4B &4E &43, to pass to the processor. Having done this, we then only need to instruct the processor to speak with &FF50. Program 2 illustrates the process.

	&8	&5	&B	&2	—		
LSN	0001	1010	1101	0100	0000	MSN	(reversed address)
+	—	—	—	0011	1100		(PHROM number)
	0001	1010	1101	0111	1100		(Result)

Figure 2. Format for 'pence'

```
650 DATA&2321,115,&25F,1
    &24C9,200
660 DATA&415,100,&175A,55,
    &3EFC,45
670 DATA&263D,55,&25F,30,
    &3153,60
680 DATA&2923,55,&21F5,40,
    &32B,100
690 DATA&415,100,&1C11,200.
    &2321,100
700 DATA&1483,22,&3153,63.
    &2923,55
710 DATA&25F,10,&1CC9,14.
    &25F,15
720 DATA&3153,64,&DBD,60.
    &1B1E,48
730 DATA0,1

>And for the poet lovers
among you,(with my
apologies to the author) :

650 DATA&1DCC,120,&2409,200.
    &1CC9,22
660 DATA&27E5,150,&16D7,170,
    &25F,25
670 DATA&633,65,&36DF,75 .
    &124D,200
680 DATA&CB3,250,&633,65.
    &36DF,75
690 DATA&21F5,40,&29DE,180,
    &124D,160
700 DATA&DBD,110,&2E9,50,
    &36DF,55
710 DATA&329A,84,&1DCC,150,
    0,1
```

Figure 3. Alternative data for program 5

		Energy	*Repeat*	*Pitch*	*K1*	*K2*	*K3*	*K4*	*K5*	*K6*	*K7*	*K8*	*K9*	*K10*
Voice	—	1011	0	101010	11100	00110	1001	0110	0101	1010	1101	100	110	001
Repeat	—	1001	1	000000	—	—	—	—	—	—	—	—	—	—
Space	—	0000	—	—	—	—	—	—	—	—	—	—	—	—
Unvoiced	—	0101	0	000000	11101	01011	0100	0011	—	—	—	—	—	—
Stop	—	1111	—	—	—	—	—	—	—	—	—	—	—	—

Figure 4. Word data frame

```
 10 REM LISTING 1
 20 DIM MC% 10
 30 P%=MC%
 40 [OPT 0
 50 .SPEAK
 60 LDA#7             \ SET A = 7
 70 LDX#(&70 MOD 256) \ LOAD INITIAL VALUES FROM
 80 LDY#(&71 DIV 256) \ START OF DATA BLOCK
 90 JSR&FFF1          \ CALL OSWORD
100 RTS
110 ]
120 !&70=&B5DFFBF     :REM LOAD CONSECUTIVE LOCs
                       WITH ADDRESS AND COMMAND
130 !&74=0            :REM FOLLOWED BY
                       PARAMETERS 3 AND 4
140 CALL SPEAK        :REM CALL MACHINE CODE
```

Program 1. Using!

```
 10 REM LISTING 2
 20 DIM MC% 35
 30 P%=MC%
 40 [OPT 0
 50 .SPEAK
 60 LDA#&9F
 70 LDY#&48:JSR&FFF4 \ PASS 1st ADDR. PARAM.(LSB)
 80 LDY#&45:JSR&FFF4 \ PASS 2nd ADDR. PARAM.
 90 LDY#&4B:JSR&FFF4 \ PASS 3rd ADDR. PARAM.
100 LDY#&4E:JSR&FFF4 \ PASS 4th ADDR. PARAM.
                     + PART OF PHROM No.
110 LDY#&43:JSR&FFF4 \ PASS PART PHROM No.
120 LDY#&50:JSR&FFF4 \ PASS SPEAK COMMAND
130 RTS
140 ]
150 CALL SPEAK
```

Program 2. Instructing processor to speak

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The processor will now access the word data and execute it. It will in fact continue to execute the word until either it reaches the end of the data, or it receives a reset command (&FF70). All we need to do, having executed the word, is to wait a suitable length of time and then send the reset command to chop the word off exactly where we require. Program 3 incorporates a double delay loop to allow for a period of 0 to 255. Again I have used indirection to set up the delay, but you can use whatever method suits your requirements. This particular example using the delay value 110 on the word 'pence', produces the new word 'pen'. You will find that both the values 0 and 255 allow any word in the vocabulary to be spoken in its entirety. You can experiment with different delay values on different words to build up a library of both complete new words or additional part words with which to concoct new words.

We can now expand this to pass any number of word/delay pairs sequentially to construct sentences. Program 4 shows one method where the calculations for the five load address commands are done for you, and where suitable word/delay pairs are read from data statements within a loop and passed to a procedure which calls the machine code. This particular method is not very elegant, as reassembling the machine code each time it is called is slow and does not promote very smooth speech. If we are going to create words from several chopped part words, the time between chopping or resetting a word to the start of the next must be negligible. Also notice that the area set aside for the machine code is fixed. If it weren't and you had a lot to say a vast amount of memory would be needed. By the way, there is no prize for guessing what this example says. It is a common occurrence in my house, where I spend too much time at the keyboard and not enough concentrating on the more basic requirements of life.

A much faster and more elegant method would be to use a machine code routine which involves no mathematical calculations and where the word/delay pairs are passed as CALL parameters. Program 5 shows just how effectively new part words can be strung together. In this example the parameter block set up by the CALL is first transferred to zero page where the relevant addresses are initially stored from &70 to &74. The delay value is then stored in &73, and subsequent manipulations for the first four load address commands are stored from &74 to &77. I don't claim this is the ultimate routine for creating speech, but it works and can be effective. If you want to try some other examples replace the data statements with those in figure 3.

There are some important tips to remember when using the above routines. First, don't be tempted to mix the machine code with Basic sound commands. Their access speeds are drastically different and they can easily get out of sync. In many in-

```
   10 REM LISTING 3
   20 DIM MC% 60
   30 FOR N%=0 TO 2 STEP2
   40 P%=MC%
   50 [OPT N%
   60 .SPEAK
   70 LDA#&9F
   80 LDY#&48:JSR&FFF4\ LOAD ADDRESSES
   90 LDY#&45:JSR&FFF4
  100 LDY#&4B:JSR&FFF4
  110 LDY#&4E:JSR&FFF4
  120 LDY#&43:JSR&FFF4
  130 LDY#&50:JSR&FFF4
  140 LDX&70              \ LOAD DELAY FROM &70
  150 .L LDY#&FF          \ INITIALISE FIRST LOOP
  160 .L1 DEY
  170 NOP:NOP:NOP:NOP \ SUITABLE ADDITIONAL
  180 NOP:NOP:NOP:NOP \ DELAY FACTOR
  190 BNEL1               \ LOOP ON &FF
  200 DEX
  210 BNEL                \ LOOP ON DELAY VALUE
  220 LDY#&70:JSR&FFF4\ RESET TO CHOP WORD
  230 RTS
  240 ]
  250 NEXT
  260 REM LOAD MEMORY WITH DELAY
  270 ?&70=110
  280 CALL SPEAK
```

Program 3. Uses delay loop

```
    1 REM LISTING 4
   10 REPEAT
   20 READ AD%,DEL%      :REM READ ADDR. AND DELAY
   30 PROCSPEAK          :REM CALL M.CODE
   40 UNTILDEL%=1
   50 END
   60 DEFPROCSPEAK
   70 FORN%=0TO2STEP2
   80 P%=&D00             :REM FIXED ASSEMBLY ADDR.
   90 [OPT N%
  100 .SPEAK
  110 LDA#&9F
  120 LDY#&40+(AD%AND&F)               \ 1st LOAD ADDR.
  130 JSR&FFF4
  140 LDY#&40+(AD%AND&F0)/&F           \ 2nd LOAD ADDR.
  150 JSR&FFF4
  160 LDY#&40+(AD%AND&F00)/&FF         \ 3rd LOAD ADDR.
  170 JSR&FFF4
  180 LDY#&4C+(AD%AND&F000)/&FFF       \ 4th LOAD ADDR.
  190 JSR&FFF4
  200 LDY#&43:JSR&FFF4                 \ 5th LOAD ADDR.
  210 LDY#&50:JSR&FFF4                 \ SPEAK COMMAND
  220 LDX#DEL%
  230 .L LDY#&FF
  240 .L1 DEY
  250 NOP:NOP:NOP:NOP
  260 NOP:NOP:NOP:NOP
  270 BNEL1
  280 DEX
  290 BNEL
  300 LDY#&70:JSR&FFF4                 \ RESET / CHOP
  310 RTS
  320 ]
  330 NEXT
  340 CALL SPEAK
  350 ENDPROC
  355 REM WORD / DELAY PAIRS
  360 DATA&2321,115,&3573,120,&1F57,135
  370 DATA&1483,24,&2923,0,0,1
```

Program 4. Calculates load address commands

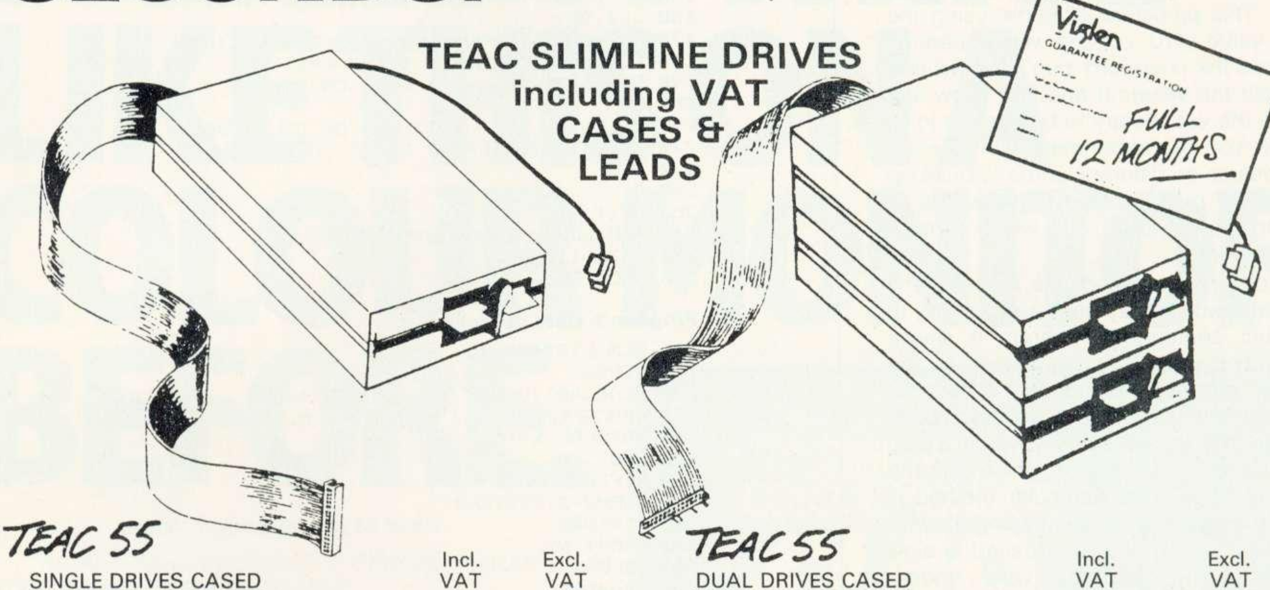
```
    1 REM LISTING 5
   10 DIM MC% 105
   20 FOR N%=0 TO 2 STEP2
   30 P%=MC%
   40 [OPT N%
   50 .SPEAK
   60 CLC
   70 LDX#4
   80 .L LDA&601,X  \ TRANSFER RELEVANT
   90 STA&70,X       \ PARAMS. TO ZERO PAGE
  100 DEX
  110 BPL L
  120 LDY#0
```

continued on page 49

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stances the delay factor you choose will be critical; a numeric difference as little as two can have a considerable effect. Unfortunately, we are always left with the sounds produced from the PHROM data, which cannot be altered. As such not a great deal can be done to alter tone, emphasis or inflection. However, judicious use of delays between words and individual syllables can provide close approximations. You can use chopped values of the two timed spaces provided in the vocabulary to help with this. Similarly, where you may have a choice of standard words which all appear to provide the same part word, you should test each one to find which has the nearest energy and pitch levels for your purpose. It's just a case of experimenting and persevering until you get what you want. Don't be tempted to rush things. Develop one word at a time and get it right before going on to the next or concentrating on inter-word spacing. Build up phrases gradually; you can always refine them later.

There is one final method available for constructing new words from scratch. Although Acorn says it can be used, it is extremely difficult. You not only have to be a linguistics expert, but also have access to very sophisticated speech analysis equipment. Because of the volume of data needed to construct each word it can also consume vast amounts of memory. Few people will be able to do it properly, so it will not be of any great value. However, there are ways to get round some of the problems.

The method involves constructing the correct data for any particular word, storing it in RAM, and instructing the speech processor to execute it. The word data is constructed in frames, each 1/40s long, and containing a number of parameter types. The parameters are energy, repeat and pitch, followed by up to 10 vocal parameters (reflection coefficients, K1 to K10). The first three are essential and determine what others are required. The energy and pitch parameters have an obvious meaning and 'repeat' provides a method of extending a sound by repeating the previous frame. The other 10 parameters represent special values to emulate the vocal tract and have a decreasing effect from K1 to K10. Typical frames, showing the number of bits required for each parameter, might look like figure 4.

All words can be constructed from these formats, but you must pack the last value with zeros to ensure the data will form complete eight-bit bytes. Having constructed the data in bit form, you take a byte at a time and form the actual numeric data values ready for processing. The first two bytes from the above, for example, would be 10110101 (181) and 01011100 (92), and so on. The next thing to do is read a byte at a time, reverse the order, and store it in an array. From the example this would produce the first two bytes as 10101101 (173) and 00111010 (58). Reverse order is necessary because of the

continued from page 47

```
130 LDA(&73),Y
140 STA&73                \ STORE DELAY VALUE
150 LDA(&70),Y            \ WORD ADDRESS (LSB)
160 AND#&F                \ CALC. 1st LOAD ADDR. p1
170 ADC#&40
180 STA&74                \ STORE p1 AT &74
190 LDA(&70),Y            \ NEXT WORD ADDR. NIBBLE
200 AND#&F0               \ CALC. 2nd LOAD ADDR. p2
210 LSRA
220 LSRA
230 LSRA
240 LSRA
250 ADC#&40
260 STA&75                \ STORE p2 AT &75
270 INY
280 LDA(&70),Y            \ NEXT WORD ADDR. NIBBLE
290 AND#&F                \ CALC. 3rd LOAD ADDR. p3
300 ADC#&40
310 STA&76                \ STORE p3 AT &76
320 LDA(&70),Y            \ NEXT WORD ADDR. NIBBLE (MSB)
330 AND#&F0               \ CALC. 4th LOAD ADDR. p4
340 LSRA
350 LSRA
360 LSRA
370 LSRA
380 ADC#&4C
390 STA&77                \ STORE p4 AT &77
400 LDA#&9F
410 LDX#0
420 .L1 LDY&74,X:JSR&FFF4 \ PASS p1 TO p4
430 INX
440 CPX#4
450 BNE L1
460 LDY#&43:JSR&FFF4      \ PASS p5
470 LDY#&50:JSR&FFF4      \ SPEAK COMMAND
480 LDX&73                \ LOAD DELAY
490 .L2 LDY#&FF
500 .L3 DEY
510 NOP:NOP:NOP:NOP
520 NOP:NOP:NOP:NOP
530 BNE L3
540 DEX
550 BNE L2
560 LDY#&70:JSR&FFF4      \ RESET COMMAND
570 RTS
580 ]
590 NEXT
600 REPEAT
610 READ AD%,DEL%         :REM WORD/DELAY PAIR
620 CALL SPEAK,AD%,DEL%
630 UNTIL DEL%=1          :REM DUMMY TO END
640 END
650 DATA&2321,118,&25F,20
660 DATA&3573,135,&415,80
670 DATA&1483,35,&2923,220,0,1
```

Program 5. Stringing together new part words

```
10 REM LISTING 6
20 REM DIMENSION DATA STORAGE
   AND M.CODE AREAS
30 DIM ARRAY% 200,MC% 50
40 REM ASSEMBLE M.CODE TO REVERSE
   EACH DATA BYTE
50 P%=MC%
60 [OPT 0
70 .REVERSE
80 STA&80:ROL&80:ROR A  \ CODE TO REVERSE
90 ROL&80:ROR A         \ EACH BYTE
100 ROL&80:ROR A        \ USING ZERO PAGE
110 ROL&80:ROR A
120 ROL&80:ROR A
130 ROL&80:ROR A
140 ROL&80:ROR A
150 ROL&80:ROR A
160 RTS
170 ]
180 REM ASSEMBLE M.CODE TO SPEAK DATA
190 FOR N%=0 TO 2 STEP 2
200 P%=MC%+27           :REM SHIFT M.CODE POINTER
210 [OPTN%
220 .SPEAK
230 LDA#&9F
240 LDY#&60             \ INITIALISE WITH &FF60
```

continued on page 51

??

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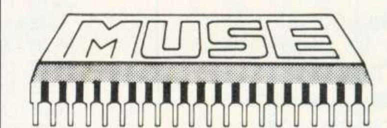
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way the speech processor buffer stores and sends the data. The final step is to instruct the processor to 'speak' the data stored in the array. This is where the remaining two commands arise. You will remember the command &FFBF to 'speak from PHROM'; we now need the command to 'speak from RAM' (speak external). There are in fact two – &FF60 must be sent with the first two bytes as this also initialises the processor to the required state; &FF00 is used with all subsequent data. Program 6 illustrates the whole process and contains the data for the word 'illegal'.

Having got this far, the only real problem left is how to work out the required data for any new word. The answer is, it's almost impossible without the right equipment. However, having said that, all is not lost. There is a way (if you're a masochist). The method requires reading the data for an existing word from PHROM, reconstituting the parameters in binary form, taking out those complete sets of parameters for the part word you want, and translating these back into numeric data values that can be used in the routine (program 6). This can be used to create new words, or to obtain part words from any section of an existing word, not just the beginning. This I will leave you to experiment with, but as a start look at program 7. I used it to obtain the data in PHROM for 'illegal'. Again, it's not too elegant, but putting in the correct address will allow you to read the data stored for any word in the vocabulary. Modifications would also allow you to store and manipulate the data as you wished. As you can see, the location of the first byte of word data is always the absolute address. However, the location of the last byte of data is not, as you might expect, the location prior to the absolute address of the next word. The last byte(s) of the data sequence contains the word name(s) of the next word (Speech Processor Manual, p29,30). A close look at the addressing loops in the program should clarify this.

A facility does exist whereby 'code values' relating to standard sets of voice parameters (energy, pitch etc) can be passed to the processor, to avoid the necessity of storing vast quantities of data. Unfortunately, Acorn cannot shed any light on how this is done, and I have, as yet, been unable to discover the information elsewhere. Time will tell.

One point remains. If you are developing software in which you wish to test for the presence of the speech processor, this is quite easy. Just try the following:

```
A%=&EB:X%=0:Y%=&FF:X%=
(USR&FFF4 AND&FF00)/&100
```

X% will be zero if the processor is not present, and &FF if it is.

I hope this quest has proved of interest. For those who already have the power of speech, at least your machine will have more to say for itself than it does at present. I hope your own experiments will be fruitful and would welcome any comments or further information as a result. ●

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```
250 JSR&FFF4
260 LDX#0
270 .LOOP                \ LOOP SENDING REVERSED
280 LDY ARRAY%,X         \ DATA STORED IN ARRAY%
290 JSR&FFF4
300 INX
310 CPY#0
320 BNE LOOP
330 RTS
340 ]
350 NEXT
360 REM CALL PROC. TO READ,
      REVERSE AND SPEAK DATA
370 PROCSPEAK
380 END
390 DEFPROCSPEAK
400 I%=-1
410 REPEAT
420 I%=I%+1
430 REM READ EACH DATA VALUE
440 READ A%
450 REM REVERSE AND STORE
460 ARRAY%?I%=USR(REVERSE)AND&FF
470 UNTIL A%=0
480 REM CALL M.CODE TO SPEAK
490 CALL SPEAK
500 ENDPROC
510 REM DATA FOR "ILLEGAL"
520 DATA164,152,50,149,246,66,239
530 DATA52,230,132,250,4,28,195,120
540 DATA105,39,14,166,210,250,187,69
550 DATA194,161,181,69,175,16,109,108
560 DATA11,107,100,212,89,107,2,221
570 DATA85,53,38,158,192,187,117,188
580 DATA77,153,16,86,93,78,149,106
590 DATA236,7,151,98,101,90,187,129
600 DATA85,230,132,10,32,238,136,137
610 DATA176,117,20,149,131,43,54,233
620 DATA108,227,98,239,18,44,95,85
630 DATA195,82,190,143,24,77,241,48
640 DATA115,172,166,81,141,59,156,218
650 DATA225,156,41,78,199,122,56,101
660 DATA8,219,193,77,213,216,197,216
670 DATA214,45,173,126,31,90,0
```

Program 6. Uses data for 'illegal'

```
10 REM LISTING 7
20 REM LOAD WORD ADDR.
      MINUS No. OF LETTERS IN WORD
30 REM .DAT PASSES A "READ BYTE"
      TO ACCESS CONSECUTIVE DATA VALUES
      FOR THE WORD STORED IN PHROM
40 REM NB THE 1st "x" No.OF BYTES,
      WHERE "x" IS No. OF LETTERS IN WORD,
      ARE THE WORD NAME(S)
50 MODE7:VDU14,10,10
60 DIM MC% 50
70 DIM DAT% 250
80 FOR N%=0 TO 2 STEP 2
90 P%=MC%
100 [OPT N%
110 .ADDR           \ LOADS ADDR. OF WORD REQUIRED
120 LDA#&9F
130 LDY#&47:JSR&FFF4  \ MUST BE WORD ADDR.
                        MINUS No. OF LETTERS
                        IN WORD
140 LDY#&43:JSR&FFF4
150 LDY#&4E:JSR&FFF4
160 LDY#&4D:JSR&FFF4
170 LDY#&43:JSR&FFF4
180 RTS
190 ]
200 P%=P%+10
210 [OPT 0
220 .DAT
230 LDA#&9F:LDY#&10:JSR&FFF4 \ SEND "READ BYTE"
240 LDA#&9E:JSR&FFF4  \ READ BYTE FROM PHROM
250 TYA               \ TRANSFER RESULT IN Y TO A
                        FOR USE WITH USR
260 RTS
270 ]
280 NEXT
290 REM CALL TO LOAD WORD ADDR.
300 CALL ADDR
310 PRINT"WORD NAMES :"'" LAGELLI  (REVERSED)"
320 REM ADDRESSES OF WORD NAMES FOR "ILLEGAL"
330 FORI%=&1E37 TO&1E3D
340 REM CALL FOR DATA IN PHROM
350 PRINT USR(DAT)AND&FF
360 NEXT
370 PRINT"DATA :"
380 REM ADDRESSES OF DATA FOR "ILLEGAL"
390 FOR I%=&1E3E TO &1EBA
400 PRINT USR(DAT)AND&FF
410 NEXT
420 PRINT"WORD NAMES (NEXT WORD) :"'"  -NI  (REVERSED)"
430 REM ADDRESSES OF WORD NAMES FOR "IN-"
440 FOR I%=&1EBC TO &1EBD
450 PRINT USR(DAT)AND&FF
460 NEXT
470 END
```

Program 7. Obtains data from PHROM



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SNAPPY WRITING

Jonathan Griffiths, author of *Snapper*, gives away some Acornsoft secrets on writing games

THIS article assumes you have mastered the art of moving a shape around the screen, and that you now wish to write a game. So, take a look at Nick Wilkinson's article first if you need to.

There are several ways of writing a game, or any program. The first is to sit down with a pencil and paper, and rough out the outline, ie how the player will be represented, how the baddies will move, what shape the screen will be, and so on. Having done this, it's time to write the main loop of the program. This is normally in a form similar to figure 1.

Note how long names are used for the subroutines – this aids legibility and the code becomes self-documenting. Once this 'top level' is out of the way, the writer can concentrate on the subroutines themselves.

The next thing to think about is the 'difficult' subroutines. Most games have some speciality which sets them apart from the others, for example in *Scramble* (*Rocket Raid*), the sideways scrolling screen is the feature, and in *Donkey Kong*, it is the large number of different things to dodge, climb, and rescue. These 'features' are usually the most difficult to program, and the author must check the idea can be done on the machine before continuing. For example, hardware scrolling cannot be used on the Electron for the smooth sideways motion required by *Scramble*, and thus it is necessary to devise some other method, or start something else.

First, however, let's think about structure. The method just described is a combination of the 'top down' approach, and the 'bottom up' approach. The terms become fairly self-explanatory if you think of the program as a tree, with the main loop at the top (all trees in computing are upside down, as the root is at the top, with the 'branches' growing downwards!), and the 'primitives' (which are the routines that do the donkey work of looking at the keyboard, plotting a shape, etc) at the bottom.

At a lower level, other things which come under the nebulous heading of 'structure' are parameters, small routines, constants, comments and look-up tables. First parameters. These are a good idea in assembler for the same reason that they are in Basic—ie they make the routine more general-purpose. Parameters can be passed to a routine in one of at least four different ways. If there are only a maximum of three single byte values to pass, the 6502 chip's internal registers (A, X, Y) can be used (this is the method used by the MOS with OSBYTE calls). Next, X and Y can together form a 16-bit address, where an information block is held – as in OSWORD calls. Another way is to leave the values to be passed on the stack (see Joe Telford's article), although this would require careful removal, as the first two bytes to be pulled would not be parameters, but would instead be the address to return to. This method is useful for recursive routines. But beware, the 6502 stack is only 256 bytes long, and if this is used heavily, it may crash (ie wrap around to the start when it gets too long). Finally, of course, the parameters can be passed into known addresses.

Small routines make the code easier to debug, which is a real necessity, although often over-looked. If it is possible to read the whole routine on one screen (without multi-line assembler statements!), then it becomes much easier to spot errors.

Constants are a good idea because to change, say, the number of ghosts chasing you, it would only be necessary to change one statement in the initialisation section. Most people write all their constants as numbers, which would mean, to do the same as before, going through the entire source code (my latest game, *JCB Digger*, has about 110k of source!), and then changing all the places where the number of ghosts was mentioned, which are not always easy to spot.

Comments are nearly always ignored when people start to program, and it is only later, when they start to wonder exactly how that amazing three dimensional plotter worked, that their value is realised. Also, many people who are brought up on Basic think of comments as wasteful, as they occupy valuable RAM. This point does not apply to assembler, which may be likened more to a compiler than to an interpreter, and the only problem is then how to get the source code into the machine. This problem can be solved – see later.

```
.enter
      JSR initialise
.mainloop
      JSR update
      JSR plotshapes
      JSR getinput
      JSR checkcollisions
      LDA dead
      BEQ mainloop
      JMP hiscore
```

Figure 1. Main program loop

Look-up tables produce fast, and often compact, code. These can be used to convert one value to another, whenever it is needed, and where there is no simple algorithm to do so. An example might be a three-times table look-up.

Long variable names, mentioned earlier, might be felt by some to be impractical in a micro with only a small memory, but these memory problems can be sorted out with a master program which takes the assembler source code in chunks, and assembles them one after the other. This means that, since all the source does not need to be there at once, there can be as many comments and long variable names as you wish.

The master program could look like figure 2. This makes use of the fact that BBC Basic allows more than one program to be resident in memory at any time. Thus the master program is always in memory, and each source file is loaded up when it is needed. Note also the way of swapping between programs. Each source file is not RUN, but is treated as a subroutine to the main program. This means that all the variables from all the source files are known about from the master program, and each source file is not aware that it's fellows are not there, as the information regarding them is known. A typical memory map might look like figure 3. Each source file should only be about 8k long, and this is the one size that can shrink if the object code and the storage for the variables gets too large. Some typical numbers in the master program (figure 2) for those with a disc machine would be:

- origin at &1900.
- if the game uses a 20k graphics mode (as most do), the area reserved for the source files would probably start at &3000
- the master program would start at about &5000, and the variables would live from the TOP of this program to the bottom of the screen (&7C00 for teletext).

With an Electron, the only differences would be that the screen would start at &6000 instead of &7C00, and you might need to shunt everything down a little, or reduce the size of your source files.

Note that I assume a disc-based system for this program because of the number of file accesses needed with two-pass as-

```
 10 origin=<start of area for machine-code>
 20 file$="ABC"
 30 PROCrun("I",<page for source files>)
 40 FOR pass = 0 TO 2 STEP 2
 50   P%=origin
 60   FOR files = 1 TO LEN(file$)
 70     PROCrun(MID$(file$,files,1),<page for source files>)
 80   NEXT files
 90 NEXT pass
100 PRINT "Object code from ";STR$~origin;" to ";STR$~P%
110 END
120
130 DEF PROCrun(name$,start)
140 PRINT name$
150 OSCLI "LOAD SOURCE"+name$+" "+STR$~start
160 PAGE = start
170 GOSUB 0
180 ENDPROC
```

Figure 2. Example master program

```
   0 REM SOURCEB
  10
  20 [OPT pass
  30 <assembler text>
   .
   .
   .
   .
1000 ]
1010 RETURN
```

Figure 4. Format for source file

```
.rnd
     LDA seed
     AND #&48
     ADC #&38
     ASL A
     ASL A
     ROL seed+2
     ROL seed+1
     ROL seed
     LDA seed
     RTS
```

Figure 5. Random number routine

sembly. You can use it on cassette if you must, but if you do, it would be a good idea to insert a line 85, saying 'PRINT "Please rewind your tape":dummy=GET', so the second pass may work. Also, don't forget to have your source files in the right order, or it won't work.

Each source file must correspond to a certain format for the master program to be able to assemble it, which is shown in figure 4. The stipulations are that there must be a line 0, or the PROCrun routine won't find the start of the code, and that the opening of the assembler must have an 'OPT pass' directive, and finally, that at the end of the file, there must be a 'RETURN' statement to return control back to the master program.

Line 30 makes a reference to a SOURCEI, where the 'I' stands for initialisation. It is this file which sets up all the tables and variables that the other source files reference. Thus all zero page allocations are done at the start, along with setting up any constants, and defining data tables. Because this is only used at the beginning, it is not necessary to have it in the loop which does the double pass.

Right, that's enough theory, let's have some useful routines! First, a random number routine (figure 5). All registers are ignored on entry, and everything except A (the accumulator) is preserved on exit. This routine simulates a 23-bit shift register, using the three bytes of 'seed'. On exit the accumulator, A, will contain a pseudo-random number. (Note that 'seed' must be given an initial value which is non-zero.)

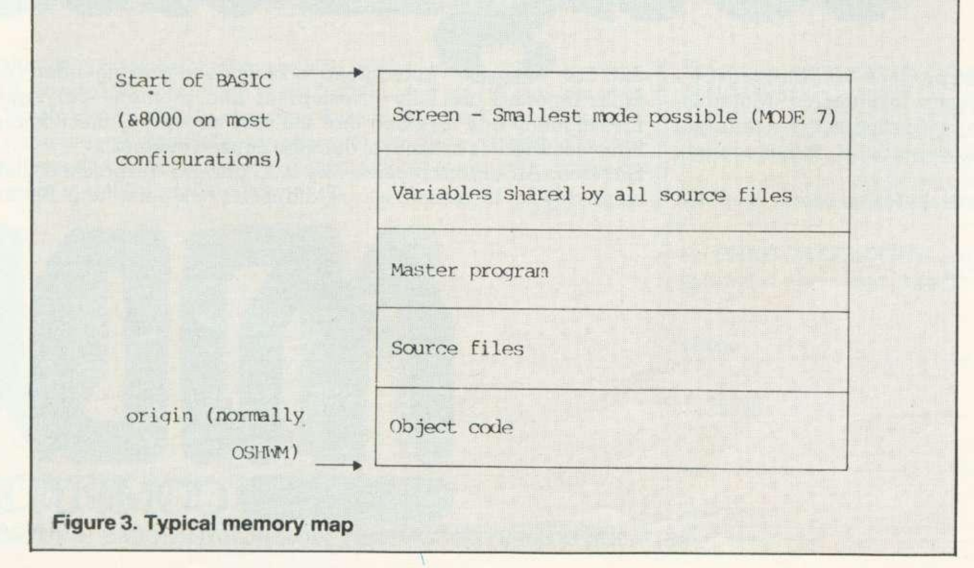


Figure 3. Typical memory map

Next, figure 6 gives a sound player in assembler. On entry, A specifies the sound to be played.

There are several interesting points in figure 6. A look-up table (soundbuffer) is used. Also, two functions are used (FNlo and FNhi). These return the low byte, and the high byte respectively, of the value passed to them. They are normally defined so:

```
DEF FNlo(value)=value AND &FF
DEF FNhi(value)=(value AND &FFFF)
  DIV &100
```

Finally, note the use of a JMP instead of a JSR / RTS at the end of the routine. This technique can also be used in Basic, where a 'GOTO x' is equivalent to a 'GOSUB x : RETURN'.

Now for a screen handling routine. This one waits for the cathode ray gun inside the VDU to hit either the top of the screen (BBC machines) or the bottom of the screen (Electrons).

On Electrons, the only sensible way to do this is by calling OSBYTE with A set to 19. Thus:

```
.vsync
  LDA #19
  JMP osbyte
```

On BBC micros, because operating system 0.1 does not have an OSBYTE 19 call implemented, it is necessary to look directly at the hardware (figure 7). (Series 1 OS does support OSBYTE 19, so the method to be described can be ignored if you only wish to write for new OS machines.)

Figure 7 is very useful for producing

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flicker-free graphics, as the shapes on the screen can be updated when the cathode ray beam isn't looking. Note that each vertical synchronisation pulse will happen every fiftieth of a second (sixtieth on American machines), and may thus be used for delays.

Now for some Basic routines for use with assembler programs. First figure 8, a utility to find a string in a program. This can be tacked onto the end of all the source files, and then called from immediate mode so:

PROCfind("soundbuffer")

to search for all the occurrences of 'soundbuffer' in that source file. Note that the routine will not find tokenised words, and that to do this, it will be necessary to reserve the first line of your source file to hold the string to search for. Thus:

```
>0DATA
>PROCfind($(PAGE+4))
```

would find all occurrences of the token for 'DATA'.

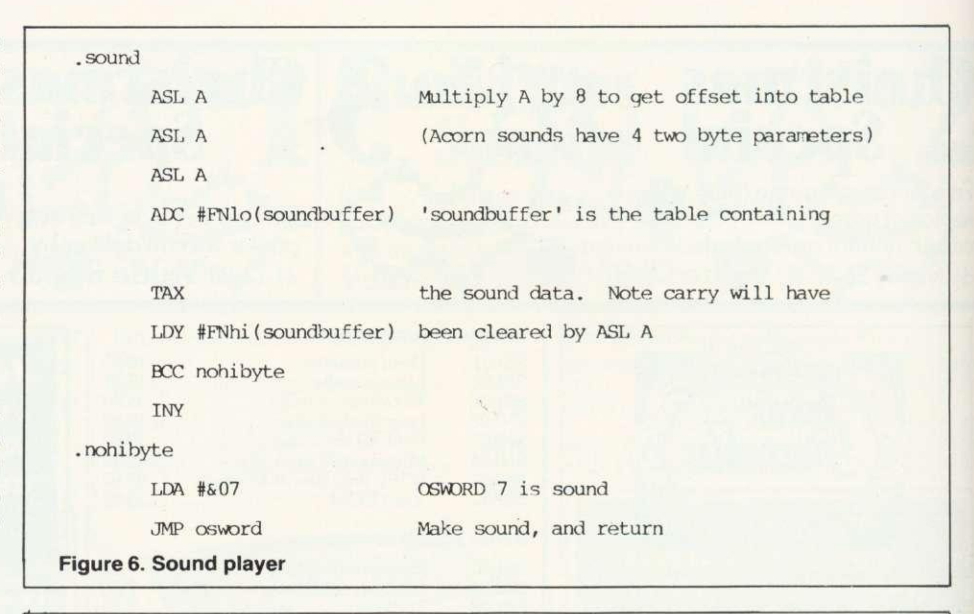
As a final note, the original BBC Basic has a bug associated with INSTR, so it is necessary to insert a 'IF LEN($A%) >= LEN(A$) THEN' before the 'IF INSTR(. . .'. (The way to find out if this is necessary is to hit break, and then type REPORT. If the message printed out is '(C) 1981 Acorn', you have Basic I).

The differences, as far as the assembler programmer is concerned, between the two Basics are:

- no OSCLI on Basic I (see later for a way around this).
- no assembler directives EQUB, EQUW, EQUD and EQUS (see Ian Birnbaum's Forum Extra in this, and the past two issues of *Acorn User*). This can also be got round.
- no ability to assemble something to one area as if it were living somewhere else. This is virtually impossible to get round easily.

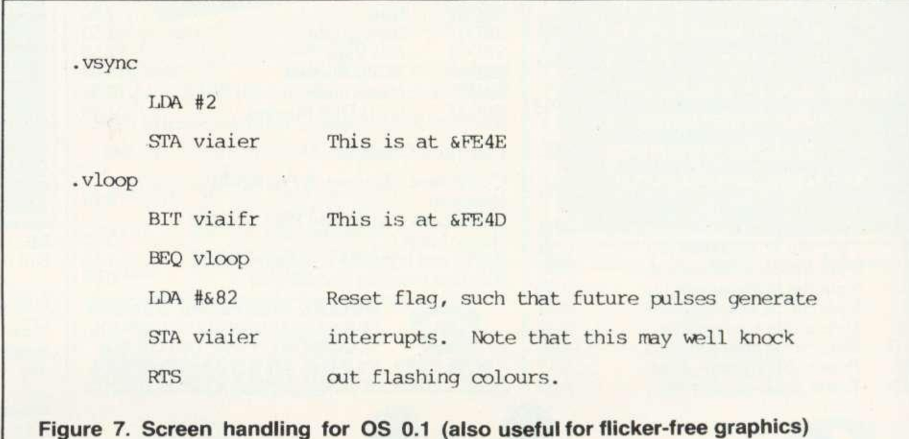
The way to simulate the OSCLI command is to define a procedure to do it for you. OSCLI takes a string as its parameter, which it then passes to the operating system command line interpreter (OSCLI). A procedure which can be directly slotted into any occurrence of OSCLI is shown in figure 9.

Simulating the assembler directives EQUB, EQUW, EQUD and EQUS is also



```
.sound
        ASL A                       Multiply A by 8 to get offset into table
        ASL A                       (Acorn sounds have 4 two byte parameters)
        ASL A
        ADC #FNlo(soundbuffer)      'soundbuffer' is the table containing
        TAX                         the sound data.  Note carry will have
        LDY #FNhi(soundbuffer)      been cleared by ASL A
        BCC nohibyte
        INY
.nohibyte
        LDA #&07                    OSWORD 7 is sound
        JMP osword                  Make sound, and return
```

Figure 6. Sound player



```
.vsync
        LDA #2
        STA viaier       This is at &FE4E
.vloop
        BIT viaifr       This is at &FE4D
        BEQ vloop
        LDA #&82         Reset flag, such that future pulses generate
        STA viaier       interrupts.  Note that this may well knock
        RTS              out flashing colours.
```

Figure 7. Screen handling for OS 0.1 (also useful for flicker-free graphics)

fairly easy. First a description of these directives which you may not otherwise be familiar with.

EQUB stands for EQUate Byte, and it takes a byte value as its parameter, and sticks the byte into the code at the current position of the assembly pointer (P%).

EQUW stands for EQUate Word, and is the same as EQUB, except it takes a two-byte value, and puts this (low byte first, in accordance with the rest of the 6502) into memory at P%.

EQUD stands for EQUate Double word (four bytes), and is an extension of EQUW. EQUS stands for EQUate String (which may be 0 to 255 bytes long). Note that only the characters are put in memory following this. There is no terminator byte, or length byte either.

Original Basic versions of these four are given in figure 10. These can all be called from assembler using the following:

OPT FNequx(value)

where the OPT statement is used to evaluate the following expression. This is why each function returns 'pass', which should be the pass number of the assembler. (NB The equs function does not mimic the EQUS directive with absolute fidelity. Instead, it leaves a CHR$13 at the end of the string (which will be overwritten by the next assembler statement) and although I cannot see how this would be a problem, it could be avoided by using a loop to write the string to memory, character by charac-

Figure 8. Assembler utility to find a string

```
DEF PROCfind(A$)
Z% = PAGE
REPEAT A% = Z% + 4
  IF INSTR($A%,A$) PRINT Z%?1 * 256 + Z%?2
  Z% = Z% + Z%?3
UNTIL Z%?1 > &7F
ENDPROC
```

Figure 9. Simulating OSCLI in Basic I

```
DEF PROCoscli(A$)
DIM X% 256
Y% = X% DIV &100
$X% = A$
CALL oscli : REM This is at &FFF7
ENDPROC
```

```
DEF FNequb(byte)     DEF FNequw(word)      DEF FNequd(doubleword)   DEF FNequs(string$)

?P% = byte           ?P% = FNlo(word)      !P% = doubleword         $P% = string$

P% = P% + 1          P%?1 = FNhi(word)     P% = P% + 4              P% = P% + LEN(string$)

=,pass               P% = P% + 2           = pass                   = pass

                     = pass
```

Figure 10. Simulating Basic II routines EQUB, EQUW, EQUD and EQUS in Basic I

ter. The reason I have not chosen this' method is that it is more cumbersome, longer, and slower, although all of these reasons only apply to the assembly process, and do not affect the final machine code.)

If you use this method of functions, together with multiple source files, you might find some very obscure errors being generated at assembly time. To understand these, you must be familiar with the way Basic handles functions (and procedures).

When Basic finds a reference to a function, it compares the name with an internal table, to see if it has come across this function before. If it hasn't, it searches through the program, looking for a matching name. Having found this, it makes a note of where the function starts in memory, so that if Basic is asked to find it again, it can go straight there, without bothering with the slow searching method. A side effect of this is that if you call a function from one source file, and then also call a function with the same name from another source file, then, instead of searching through the second file, Basic will jump directly to where it found the function last time, and thus it might do anything. Of course, if the second file was significantly shorter than the first one, there is a fair chance the function definition is still in memory, and thus everything will work, but obviously, it is hardly reliable.

The way to avoid this problem is to have a separate file, which is always in memory, and which contains all the function definitions used by all of the source files. But also, this new file must call all the functions before any of the functions are called by Basic, so the addresses are known. Thus a function source file would probably look like figure 10. The dummy variable A% is used to evaluate (and thus remember) all of the functions. Note that for this dummy run, the value of P% is just somewhere where it won't do any damage.

Also, a line will need to be added to the master program, before loading any other source files, to 'PROCrun("F",<page reserved for function library>)'.

And now, as they say, for something completely different. Screen scrolling is one of the few subjects that appears to crop up again and again, and so here is my version of how to do it.

On both BBC micro and Acorn Electron, the potential screen sizes (in terms of memory) are quite large, and thus to scroll 20k of memory fast is no easy task. In fact,

```
 0 REM SOURCEF

10 P%=&B000 : REM Somewhere
                  in the ROM
20 A% = FNlo(0) + FNhi(0) +
            FNequb(0) + ....
30 RETURN

40

50 DEF FNlo(value)....
```

Figure 11. Function source file

if one defines a text window to be the size of the screen in mode 0, by typing:

```
MODE 0
VDU 28,0,31,79,0
```

and then scrolling the screen, one can see just how slow it is. To get around this problem, Acorn decided to incorporate hardware scroll, in which a section of the hardware (the 6845 chip on BBC machines, and a section of the ULA on Electrons) is dedicated to keeping track of the top of the screen.

To scroll the screen, one merely changes the 'top of screen' pointer, and the hardware takes care of the rest. Thus on the BBC machine, to scroll the screen up one line, type:

```
MODE 6
VDU23;12,&0C;0;0;0; :
VDU23;13,&28;0;0;0;
```

and on the Electron, type:

```
MODE 6
?&FE02=&A0 : ?&FE03=&30
```

(This could be implemented using *FX151 to write to Sheila, if you want it to be Tube-compatible!).

On both machines there are two registers which together form the high and low bytes of the address that represents the top of the screen. On the BBC machine, one has to divide the memory address by eight to get the value to put into the registers, and on the Electron, one must divide the address by two. In mode 6, the screen memory normally starts at &6000, and since each line is 320 (&140) bytes long, to scroll up one line (ie move the start of screen up by &140), we must write the modified version of &6140 into the registers. Note that the memory which 'falls off the end', in fact reappears at the bottom of the screen, and thus there is a discontinuity in the memory map, as the memory now goes from &7EC0 through &7FFF, and then starts going up again at &6000. This means that any shape plotting routines that you have must keep a track of this barrier, and allow for it when plotting the shape. Also, if you have an (X,Y) to address function, this will also have to allow for the fact that the top-left corner of the screen no longer occupies a fixed position in memory, but instead moves about, and also that there is a barrier on the screen.

A further point to notice is that, since the value put into the registers is divided by something, this is the minimum by which you can scroll at any one time. (The Electron is in fact worse, not better, than the BBC machine here, as the bottom five bits are ignored, so that the resolution of the scrolling is only to the nearest 64 bytes, as opposed to eight bytes on the BBC machine.)

To round off, here are some words about the palette, which also appears to be a bugbear for most people.

The palette can be thought of as just a mapping between two tables. One of the tables always runs from 0 to 15 (the logical colours), and the other table can vary:

Logical colour (in memory)	Physical colour (displayed on screen)
0	Black (0)
1	Red (1)

and so on. To change the mapping, just tell the machine to make logical colour 1 point to physical colour green (number 2). Now, whenever you white something in colour 1 to the screen, it will come out in green. Note that if you are using mode 2 to practise this in, you will have two greens, which you won't be able to tell the difference between on the screen. However, to the computer, the colours are different, and if you use POINT to look at the colours of the points at (X,Y), then you will notice there are still two different colours, 1 and 2.

The way this works is that as each byte is read from the screen memory by the ULA, it looks up in its internal mapping array what colour that number should be displayed as, and then it tells the cathode ray guns to display that colour. Thus the memory isn't changed when you change the palette, but instead the hardware remembers the mapping which lets you change the colour of selected areas of the screen very fast.

● Jonathan Griffiths is the author of Acornsoft's *Snapper, Rocket Raid,* and *JCB Digger*. His book *Creative Assembler* will be published by Acornsoft in the New Year.

Paul Beverley uses his Electron interface to download software – 14k in 30 seconds!

PARALLEL LINK TO THE BEEB

LAST MONTH I explained how to attach a 6522 versatile interface adaptor (VIA) to your Electron to enable you to do some interfacing and showed you how to make a link with a BBC micro via the cassette port for the transfer of software. Here I'll explain how to make a parallel connection between a BBC micro and the Electron to enable you to download programs at high speed. With this method it takes less than 30 seconds to load a 14k program into the Electron.

The hardware described in the December issue is sufficient to enable you to do this. The only other item you need is a 26-way IDC connector and cable to link the 6522 VIA adaptor to the printer port of the BBC.

How does data-transfer along parallel cables take place? The data to be transmitted between the two computers is carried, a byte at a time, on the eight data lines from the printer port of the VIA on the BBC micro to the eight lines of port B of the VIA attached to the Electron. But there has to be some means of synchronising the transfer. For this purpose two control lines are used, one from the sending computer (BBC) to say that the data is ready to be accepted, and the other from the receiving computer (Electron) indicating that it has read the data and is ready for the next byte. To do this the CA2, the 'strobe' output of the BBC printer port, is connected to CB1 on the Electron, and the CB2 output from the Electron connected to the CA1 input on the BBC, the 'acknowledge' input.

To get the Electron to accept the data from the BBC it must carry out the handshaking just as a Centronics-type printer would. Special machine code routines are needed to carry out the hand-shaking automatically and to put each character received into the keyboard buffer. The operating system then deals with them as though they had come directly from the keyboard and enters them as lines into the program area. It is equivalent to EXECing a piece of text coming from a file system.

When the BBC sends a strobe pulse it can be used by the VIA to generate an interrupt. The response to this interrupt is to accept the data from the port, feed it into the keyboard buffer and send an acknowledge pulse to the BBC.

The earliest way of doing this was to use a single interrupt routine which took in the data and immediately sent out an acknowledge pulse. The problem was that the keyboard buffer soon became full, the rate at which the BBC could send the data being much greater than the rate at which the Electron could receive it. Attempts to solve this problem by getting the operating system to generate a 'buffer full event' produced a far more complicated program which improved performance only slightly.

Then with help from the *Advanced User Guide* it was discovered that every time the operating system removes a character from the buffer it indirects through a vector at &22C. If you intercept this vector and send out an acknowledge pulse only when a character is about to be taken out of the buffer there will never be more than two characters in the buffer at a time; the speed at which the BBC is allowed to send the data is controlled by the speed at which the Electron can store the characters in the form of a Basic program.

This method seemed to work, apart from an occasional loss of a single byte of data. This could have been because the routine was using the second interrupt vector, IRQ2V, bringing about delay between receiving and interrupt from the BBC and actually servicing it. The interrupt is not dealt with until the Electron operating system has gone through all its own interrupt routines to find out whether it was an internally generated interrupt.

The solution is to use IRQ1V rather than IRQ2V. This is the vector through which the operating system indirects before it starts its own routines. Thus the routine which you put into the Electron should check whether the interrupt has come from the VIA and if so service it, and if not return to the normal IRQ routines. With this modification data transfer seems secure.

Listing 1 shows the source code for the machine code routines that have to be put into the Electron. This could be assembled and put on to a cassette ready to be *RUN into the Electron. But as we are using a disc-based BBC computer it is possible to do without a cassette by linking the cassette ports of the two computers – as explained last month. All that is needed is to cross-connect the output from one cassette port to the input of the other and vice-versa, and add a 1.5k resistor to earth on each line.

Running the program as listed assembles the machine code program and prepares to *SAVE it across to the Electron. It prompts the user with 'RECORD then RETURN', at which point you type in *RUN on the Electron (or */ for short), press RETURN and then press RETURN on the BBC. This will LOAD and RUN the machine code program into the Electron, and it is then ready to receive normal Basic programs.

To send the programs you LOAD them into the BBC computer from disc and then use function key 2 to LIST them across to the Electron. The machine code program in the Electron itself sets up three of the function keys to ease the use of the routine and then puts the letters NEW and a carriage return into the keyboard buffer to clear out any old program in the Electron. If there is already a program in the Electron using line numbers that are not used in the new program these lines will be retained.

As long as the machine code programs within the Electron are active, they are being used by the operating system every time an interrupt occurs or a character is removed from the keyboard buffer. This causes a marginal slowing down of the processing speed but, more importantly, if your program uses the area of RAM in which the routines are stored it will corrupt them and the system will crash. Thus by pressing the BREAK key, which has been programmed with 'OLD', the vectors are restored to their original values and the routines are no longer active.

This also explains the use of what might seem to be a strange area of RAM on the BBC computer – page &D00. Any other page of RAM on the Electron may well be used by one of the programs being sent across and RUN.

After setting up three function keys on the BBC, the values of various registers and vectors are set up (lines 50-100). Lines 160-640 are the setting-up routines used within the Electron to remove and remember the old interrupt vector and the old remove-a-character vector and replace them with the addresses of the new routines. Lines 360-400 set up the peripheral control register and the interrupt enable register of the VIA, and lines 420-520 set up three of the function keys on the Electron by means of the OSCLI routine at

&FFF7. Then at lines 540-640 the word NEW followed by a carriage return is inserted into the keyboard buffer.

The interrupt routine itself starts at line 670 and involves looking at the interrupt register to find out whether an interrupt has been generated in the VIA and, if not, returns through the indirect jump at line 810. If an interrupt has been generated in the VIA then, after saving the X and Y registers, the value is picked up from port B. By using OSBYTE routine 138 the character is inserted into the keyboard buffer. The registers are then restored and the interrupt routine ended with an RTI.

At line 790 the new remove-a-character routine starts by sending a zero-one pulse out on CB2 by changing the value in the peripheral control register. You then jump back to the old vector to continue the routine that actually removes the character from the buffer.

The remainder of the routine gives space to store both the strings used for programming the function keys and the two old vectors. Finally, the machine code program assembled within the BBC is *SAVEd out to the Electron at line 1110.

When the BBC has finished its listing it sends a '>' character (the Basic prompt) down to the Electron. If you then start to type something into the Electron keyboard, such as RUN, the prompt character in front of it will cause a syntax error. So, for sending out the listing, key 2 on the BBC has been programmed so that it follows the listing with a control-A and a control-M. This sends a single carriage-return to the 'printer only', ie to the Electron, so that although the prompt character itself generates a syntax error, the Electron is ready to accept a new line from the keyboard.

There remains a problem with this method, which arises when the program to be sent includes long lines: it is possible by using abbreviations to type in a program line of less than 256 characters which, when listed out as a line with full Basic keywords, is longer than 256 bytes. Such output will not be accepted by the Electron as a line that it can feed into its program. You must therefore either split the line on the BBC before sending it, or re-send the individual line using abbreviations. You will know this problem has occurred if the Electron gives a bleep.

If you want to send a single line from the BBC to the Electron, type control-B, move the cursor on the BBC to the line to be copied, press the copy key to copy the line and then type control-A and control-M to send a carriage return to the Electron. Then press control-U to cancel the line on the BBC and control-C to stop sending from the BBC to the Electron.

The next project for the Electron will enable you to drive a Centronics-type printer by adding a printer interface to the VIA and writing a printer driver routine. ●

```
 10 *KEY0*CAT|M
 20 *KEY1*DISC|M LOAD"
 30 *KEY2LIST|B|M|A|M|C
 40
 50 portB=&FCC0
 60 PCR=portB+12
 70 intREG=portB+13
 80 IER=portB+14
 90 IRQ1V=&204
100 RemV=&22C
110
120 FOR opt=0 TO 2 STEP 2
130   P%=&D00
140   [OPTopt
150
160   RTI           \ For NMI's on BBC
170   SEI
180   LDA IRQ1V   \ Change interrupt vector
190   STA oldIRQV
200   LDA #newIRQ MOD 256
210   STA IRQ1V
220   LDA IRQ1V + 1
230   STA oldIRQV + 1
240   LDA #newIRQ DIV 256
250   STA IRQ1V + 1
260
270   LDA RemV \ Change remove character
                 vector
280   STA oldRemV
290   LDA #newRemV MOD 256
300   STA RemV
310   LDA RemV + 1
320   STA oldRemV + 1
330   LDA #newRemV DIV 256
340   STA RemV + 1
```

continued on page 65

OS PROBLEM

WHILE developing this program, I discovered a slight problem with the Electron's operating system. It only becomes apparent if you try to *RUN a machine code program as the first file system operation after switching on the machine. There is no problem with LOAD, or *LOAD.

What happens is that when you come out of the machine code program which you have just *RUN, back into Basic, you get a spurious 'Syntax error', and sometimes the system will not allow you to type in a program without first pressing the break key.

It appears that *RUN (or */) does not set up the value of one of the flags used by the cassette filing system as it should. The actual effect which results depends on the value the flag byte happens to assume on power-up.

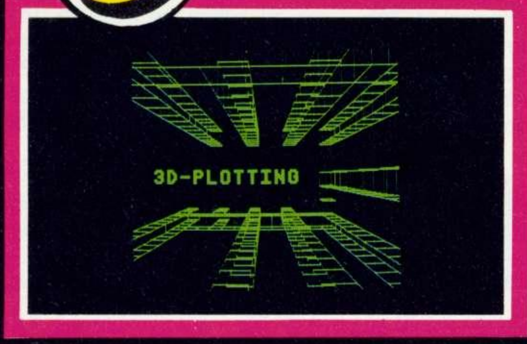
This same 'feature' is also present in the BBC micro's operating system 1.2, but because of the consistency with which its RAM powers up, it has not previously been noticed.

When using my software downloading program, or the printer driver routine, you are likely to want to *RUN the machine code program immediately after power-up. To solve the problem either:

- ***LOAD the program and then CALL &C00 (or wherever you have put it).**
- **Type LOAD"" <return>, and <escape>, and then you can *RUN the program as normal. This is because the LOAD command will have set up the flag byte correctly.**
- **Put a single-line Basic program which consists of 10 *RUN in front of the machine code program, and then chain it.**

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continued from page 63

```
350
360   LDA #&EE
370   STA PCR            \ CB2 = 1 output
380   LDA #&90
390   STA IER            \ Enable interrupts on CB1
400   CLI
410
420   LDX #key10 MOD 256 \ Program various keys
430   LDY #key10 DIV 256
440   JSR &FFF7
450
460   LDX #key1 MOD 256
470   LDY #key1 DIV 256
480   JSR &FFF7          \ OSCLI routine
490
500   LDX #key0 MOD 256
510   LDY #key0 DIV 256
520   JSR &FFF7
530
540   LDA #138           \ Put NEW in keyboard buffer
550   LDX #0
560   LDY #ASC "N"
570   JSR &FFF4
580   LDY #ASC "E"
590   JSR &FFF4
600   LDY #ASC "W"
610   JSR &FFF4
620   LDY #13
630   JSR &FFF4
640   RTS
650
660   .newIRQ
670   BIT intREG      \ Check for CB1 interrupt
680   BPL return      \ If not, return
690   TXA:PHA         \ Save registers
700   TYA:PHA
710   LDY portB       \ Get character
720   LDX #0
730   LDA #138
740   JSR &FFF4       \ Put in keyboard buffer
750   PLA:TAY         \ Restore registers
760   PLA:TAX
770   LDA &FC         \ Restore accumulator
780   RTI             \ End of interrupt routine
790
800   .return
810   JMP (oldIRQV)
820
830   .newRemV
840   LDA #&CE        \ Send acknowledge pulse
850   STA PCR
860   LDA #&EE
870   STA PCR
880   JMP (oldRemV) \ Remove character from buffer
890
900   .key10
910   EQUS "KEY10OLD|M"
920 EQUB 13
930
940 .key1
950 EQUS "KEY1NEW|M"
960 EQUB 13
970
980 .key0
990 EQUS "KEY0CALL&D01|M"
1000 EQUB 13
1010
1020 .oldIRQV
1030 NOP:NOP
1040
1050 .oldRemV
1060 NOP:NOP
1070
1080 ]
1090 NEXT
1100 *T.
1110 *SAVE X D01 DC0 D01
1120 *D.
```

Listing 1. Downloading programs from BBC micro to Electron at high speed. Source code for Electron machine-code routines.

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LESS PEEKING says George Hill

THERE were two 'naughty but nice' things in October's Forum. First, was the reference to locations for various flags and parameters which are stored in the nether regions of memory by the operating system.

One letter referred to the values for the co-ordinates of the graphics cursor. Far be it for me to spoil people's fun, but I do see a danger of becoming Pet-style programmers, endlessly peeking and poking. All the information required by John Swift is available through the operating system.

In fact almost all the information you could conceivably need is available through the OS. May I suggest the purchase of the new *Advanced User Guide*, and a deep perusal of the OSWORD, OSFILE and OSBYTE calls amongst others.

The parameters Mr Swift required were those for the X and Y co-ordinates of the graphics cursor. These are accessible by a Basic routine (listing 1), which is guaranteed to work with any future OS. This method translates into assembly language as listing 2. (Note that it gives results which must be divisible by four in mode 1.)

It has the advantage that the values of the cursor positions are produced in locations which *you* control, and which are not subject to change – although it is longer to write, and slower.

Another set of parameters required in Forum by Mr R Lewis was the load finish and execute addresses of a file. The method suggested by S Munn for OS0.1 suffers from the same disadvantages as the previous peek-and-poke method, ie it is not transportable across OS changes.

Listing 3 shows how to use OSFILE to obtain the parameters in a similar way to listing 1. The method can also be translated into assembly language. The program uses byte indirection extensively and the 'decoding' of the addresses is rather peculiar. This is caused by the fact that, for Basic files, the addresses are stored with the 16 most significant bits set ie, address &1900 appears in the parameter block as &FFFF1900. This is not true of machine code or other files.

If you must peek and poke memory, many of the locations are now documented in the *Advanced User Guide*. One which I have scrupulously avoided using directly is &355 which contains the value of the current mode. (Location &387 in OS0.1 if memory serves!)

THANK you for these elegant routines, George. As for your comments, they are in essence similar to a warning I gave, but they go somewhat further than I would want. There are two reasons for this. The first is that not all the *FX calls available in the series one operating system are available in OS0.1.

Second, I am not convinced that everything which can be done by direct memory access (what you call peek and poke methods) can be done by operating system calls. However, one of the reasons for publishing direct access calls is to stimulate readers to respond with methods using OS calls, if they exist.

To start the ball rolling, I offer the following challenge. In my *Beeline* word processing program it was necessary to move the cursor to a predefined point on the screen as if the cursor controls had been pressed. This allows the copy key to be pressed at once, without using any cursor keys first. The code to achieve this is in listing 4.

page 68▶

THE Forum's aim is to exchange ideas, tips and applications for BBC micro and Electron. Chaired by Ian Birnbaum, it enables more experienced programmers to present ideas, which must draw on earlier Forums or be original. In either case, it should be described clearly and fully, with listings supplied. At least £5 will be paid for any tip published. The main judging criteria are originality, and skill in implementing a routine. Your contribution should be typed or printed, with any substantial listings on cassette, but only included to make a point.

SPACE ERROR

TYPE this short program into your computer:

```
10 *KEY10 OLD|M RUN|M[space]
20 GOTO 20
```

Make sure you leave a space at the end of line 10 – this is important, as you will see.

Run the program and press the break key. The result will be a 'Key in use at line 10' error.

Now copy line 10 without the final space, and re-run. Then break works as expected, with no error message.

The error occurs because when run is activated, part of the contents of key 10 – namely the space – remains to be executed. Hence, when line 10 of the newly re-run program is executed it fails, because the operating system will not allow the definition of a key, part of whose contents remain in the buffer.

Yet another example of how unwanted spaces can have unintended effects in BBC Basic programs!

```
 10 REM GCURSOR
 20 REM To read the current positon of
      the graphics cursor.
 30 OSWORD=&FFF1
 40 DIM graphics_cursor 7
 50 A%=&D
 60 X%=graphics_cursor MOD 256
 70 Y%=graphics_cursor DIV 256
 80 CALL OSWORD
 90 previous_cursor=!graphics_cursor
100 current_cursor=graphics_cursor!4
110 current_X=current_cursor MOD &10000
120 current_Y=current_cursor DIV &10000
130 PRINT"X=";current_X
140 PRINT"Y=";current_Y

MODE1
>MOVE773,1089
>RUN
X=772
Y=1088
```

Listing 1. Graphics cursor from Basic with RUN result

```
 10 REM GCMAC
 20 REM To read the current graphics
 30 REM cursor via assembly language
 40 OSWORD=&FFF1
 50 DIM space 20
 60 P%=space+8
 70 [OPT 2
 80 .find_cursor    lda #&D
 90                 ldx #space MOD 256
100                 ldy #space DIV 256
110                 jsr OSWORD
120                 rts
130 ]
140 CALL find_cursor
150 PRINT"X=";space!4 MOD &10000
160 PRINT"Y=";space!4 DIV &10000
>MODE1
>MOVE125,689
>RUN
X=124
Y=688
```

Listing 2. Cursor from assembler with RUN result

```
Cassette Data: O.S. 1.2

3B2  53  ) FILENAME
3B3  4B  )
3B4  45  )
3B5  54  )
3B6  43  )
3B7  48  )
3B8   0  )
3B9  FF  )
3BA  FF  )                3C2  23  ) EXEC ADDRESS
3BB  FF  )                3C3  80  )
                          3C4  FF  )
3BC  FF  )                3C5  FF  )
3BD  FF  )
                          3C6   7  ) BLOCK NUMBER
3BE   0  ) LOAD ADDRESS   3C7   0  )
3BF  19  )
3C0  FF  )                3C8  DB  ) DATA BLOCK LENGTH
3C1  FF  )                3C9   0  )

The above information can transfered
to integer variables as follows:-

A%=?&3C6*256+?&3C8  (Program Length)

B%=(!&3BE)AND(&FFFF)  (Load Address)

C%=(!&3C2)AND(&FFFF)  (Exec Address)
```

Table 1. Cassette filing system workspace

```
10CLS:PRINTTAB(1,2)"ABCDEFG"TAB(1,2);:IF?&FFFE=
164THEN?&36B=&42:?&372=&54:?&374=&52:?&37D=&18 ELS
E ?&364=2:?&365=24:?&D0=66:INPUTTAB(0,5),A$
```

Listing 4. Copy without cursors

from page 67

If you type in and run this listing, you can use the copy key at once to make a copy of ABCDEFG into A$ in the INPUT statement. It will work on both operating systems (the contents of &FFFE dictate which part of the code is executed). Can anybody do this using OS calls only?

Readers who would like to enter the debate on direct memory access versus OS calls are invited to write to the Letters pages.

CASSETTE SPACE

£5

AT THE risk of offending George Hill, I include this month an answer to Mr Lewis' question for OS1.2 from Steven McLean.

Details of the cassette filing system workspace for OS1.2 are given in table 1. It also shows how the information can be stored in integer variables as queried by R Lewis (October, page 57).

M/C BASIC

by Eddie Atherton

£5

FOLLOWING October's Forum, I have a few comments to make.

The article about saving Basic programs as machine code and then using *RUN to execute them will only work properly in a small percentage of cases.

Loading a program using *LOAD or *RUN will not set the value of the Basic variables PAGE or TOP. This will result in the famous 'bad program' if the program is loaded at a different location than PAGE is currently set at. If PAGE was correct, the chances of TOP (and therefore LOMEM) being right are even slimmer. The result of this is that any variables created in the Basic program will be stored at the wrong locations in memory, causing a variety of problems including 'No room', 'Bad mode' or even overwriting the Basic program.

The problem of LOMEM can be corrected by including the command END (RETURN) before the RUN in the machine code driver, but I can think of no method of setting PAGE correctly.

QUITE right, Mr Atherton. This unfortunately escaped my notice on the final checks. Putting OLD or END before RUN ought to cure the problem of TOP, but it unfortunately causes other problems. However, see Ben Clarke's piece for another approach.

```
 10 REM FILEADR
 20 REM To read the LOAD FINISH and EXECUTION addresses of a file
 30 OSFILE=&FFDD
 40 DIM osfile_parameters 17
 50 DIM filename 10
 60 INPUT"Filename",filename$
 70 filename$=LEFT$(filename$,7)
 80 $filename=filename$+CHR$13
 90 osfile_parameters?0=filename MOD 256
100 osfile_parameters?1=filename DIV 256
110 A%=5
120 X%=osfile_parameters MOD 256
130 Y%=osfile_parameters DIV 256
140 CALL OSFILE
150 load_address=osfile_parameters?2+256*osfile_parameters?3
160 exec_address=osfile_parameters?6+256*osfile_parameters?7
170 length=osfile_parameters?10+256*osfile_parameters?11
180 finish_address=load_address+length
190 PRINT"Load      address=";~load_address
200 PRINT"Execution address=";~exec_address
210 PRINT"Finish    address=";~finish_address
```

```
>RUN
Filename?FILEADR
Load      address=1900
Execution address=801F
Finish    address=1BC1
```

Listing 3. Using OSFILE to obtain parameters with RUN result

LOCKED FOR PROGRAM PROTECTION by Ben Clarke

£20

WHILST prodding around in the darkest depths of OS1.2, I found the enigmatic message 'Locked', which appeared to be concerned with the loader code. Further investigation showed it was dependant upon the least significant bit being set in the 'Block flag' byte of the cassette header (*User Guide*, page 399). If this bit is set, the only way the program can be loaded, without the 'Locked' message appearing, is via *RUN. It also proved to be the case that programs loaded via this mechanism acted as though *FX200,3 had been actioned, ie, the escape key was disabled and RAM was cleared from &400 upwards when break was pressed.

This all looked pretty good for program protection but for two problems: getting the Locked bit set on a save, and how to make a Basic program start after *RUN (machine code is OK).

Looking even deeper into the operating system showed no obvious way of setting the locked bit, so, in the end, I resorted to 'stealing' the relevant save code from ROM into RAM and then modifying it to do what was required. Then all I had to do was alter the OSFILE vector to point to my doctored code.

However I couldn't find a convenient point in Basic for a direct entry so I had to arrange to obey OLD followed by RUN. Putting them both in the keyboard buffer didn't work, as it gave syntax errors. However, putting &F9 (the code for RUN) followed by a carriage return into the buffer, and putting carriage return into the 'Run time buffer' (at the address pointed to by &B/C modified by &A), then jumping to the code for OLD worked fine. Basic actions the OLD then looks in the buffer for the next command, where it finds RUN.

All the above has to be obeyed after the program has loaded, of course, so must be present when it is recorded by a *SAVE. The Basic is upset by finding REMs containing characters less than &1F, so line 0 jumps around line 1, which is a REM into which the machine code is assembled.

All that now remains is to 'crashproof' your program. Make sure there are no ends or stops laying around, and add:

ON ERROR GOTO 5 and
5 CALL&D9CD

to force break and clear store (make sure you've got all the bugs out first – debugging a program which deletes on error is nasty!).

The result of all this is a program which can only be loaded via *RUN, so immediately RUNs itself, cannot be broken into, and, if break is pressed, clears the whole store – about as tamper-proof as you can get.

There are seven stages to go through.

- Type:
  FOR I%=&C00 to &CFF:?I%=I%?&E600:NEXT

This relocates the save code to C00 to CFF (it can be moved if required)

- Type:
  ?&CE4=&A9:?&CE5=&81:?&CE6=&8D

This modifies the code to add in the locked bit.

- Add to program:

  0 GOTO 10
  1 REM followed by at least 23 spaces

- Type:
  P%=&E0E:[LDA#&8A:LDX#0:LDY#&F9:JSR&FFF4:LDY#&D:JSR&FFF4:LDA#&D:LDY&A:STA(&B),Y:JSR&8A3D]

Note that this must be typed as one line. The code to insert the characters into the buffers is assembled into the REM line, ready for saving.

- Type:
  ?&213=&C

This alters the OSFILE vector to point to the modified code

- *SAVE "progname"E00 xxxx E0E

Where xxxx is the top of Basic store in hex. (Typing PRINT ~ !0 gives an eight-digit hex number, the last four of which give the number required.)

- Type:
  ?&213=&F2

This reverts the vector to normal

Try loading the program by LOAD,CHAIN, *LOAD. You should get 'Locked' to all three. Then try *RUN when the program should load and run.

```
10 REM By R Phillips & R Ward
20 *FX5,1
30 VDU2,21
40 PRINT"  "
50 VDU6,3
60 IF ADVAL-4=63 THEN 90
70 *FX15,0
80 *FX5,0
90 REM Begin output to printer
```

Listing 6. Tests printer buffer

```
10 REM Program to list all user defined keys
20 REM By J Nelson
30 PRINT"Character space remaining: ";255-?&B10
40 FOR K%=0TO15
50 IF ?(&B00+K%)=?&B10 THEN PRINT"Key ";K%;" Un
defined":GOTO 180
60 S%=?(&B00+K%)+1
70 E%=?&B10
80 FOR I%=0TO15
90 L%=?(&B00+I%)
100 IF L%>S% AND L%<E% THEN E%=L%
110 NEXT I%
120 PRINT"Key ";K%;" ";
130 FOR I%=0TOE%-S%
140 L%=?(&B00+S%+I%)
150  IF L%>=&20 THEN PRINTCHR$(L%); ELSE IF S%+I
%<>E% THEN PRINT'""
160 NEXT I%
170 PRINT
180 NEXT K%
190 END
```

Listing 5. Prints out function key definitions

FUNCTION LIST

£5

LISTING 5 from John Nelson provides a way of printing out the function key definitions without having to press the keys themselves. The program prints the number of characters remaining in the buffer and then the current definitions for the 16 keys (red keys 0 to 9, break key, four cursor keys and the copy key).

The operation is as follows. Key definitions are kept in page &B, ie from &B00 to &BFF and the address of the last occupied byte is found in &B10 – all addresses are within page &B. The first 16 bytes are allocated one to each key beginning with red key 0. If the key is undefined, the address stored for that key is the same as that in &B10, otherwise the address is one less than the start of the key definition. The program then scans the first 16 bytes to locate the end address of the key definition and prints the characters. Characters with ASCII values less than 32 are treated as a signal for a new line.

PRINT TEST

£5

PROGRAMS which output to a printer will hang up with a full printer buffer if the printer is not on-line, connected and switched on. Many programs therefore use a 'Do you want a print out?' option. Listing 6 avoids this by testing the printer buffer. If the buffer is being emptied, output proceeds normally, but if it is not being emptied, the printer sink command is executed. This routine came from Richard Phillips and Robert Ward.

Malcolm Banthorpe grows his own crystals with some eye-catching programs

LIFE VARIATIONS

MANY readers will be familiar with J H Conway's game of Life. In its simplest form, Life is a simulation of a group, or groups, of cells whose existence is governed by three simple rules. The world in which the cells exist consists of a rectangular grid, each division of which can either be empty or contain one cell. The existence of a cell and the 'birth' of new ones is determined by the contents of the eight locations which immediately border the location under test (figure 1). The three rules are:

- a cell survives to the next generation if it has either two or three neighbours;
- a cell dies if it has less than two, or more than three neighbours;
- any empty location which has exactly three neighbours gives birth to a new cell.

These simple rules can lead, after a few generations, to complex patterns which would be difficult to predict.

Most Life programs are designed to study small groups of cells, but the same rules are applied here to larger groups, by using a higher resolution display than is generally employed.

A requirement of any Life program is that the nine neighbours of every screen location be examined before the status of any location is changed. Any changes which were made during the examination would affect the inspection of subsequent locations and effectively change the rules. It is therefore generally necessary to store the next generation, without changing the display, until the examination of the whole field is complete. This is normally done using an array, so the size of the field is limited by the memory available. Thus most programs use a fairly low resolution display of about 1000 locations; 40×25 being typical, as it matches the text screen format of many small computers.

My initial attempts at a high resolution program were on an ITT 2020 (Apple) computer, which had a potential 69,120 locations on its 360×192 display. Clearly the use of an ordinary integer or real array to store the next generation was out of the question. Other than storing the next generation on disc, it would be necessary to store the status of each location in a single bit (just as the high resolution screen buffer does in an Apple). The Apple has two high resolution screen buffers, either of which can be selected by software for display. A program was therefore devised which would solve the problem by displaying alternate generations on alternate high resolution screens. The sequence of events was: set up initial sequence on screen 1; display screen 2, examine screen 1 and plot next generation on screen 2; display screen 1, examine screen 2 and plot next generation on screen 1; go back to the second stage.

As might be expected, Basic was too slow. For every generation, each of the 69,120 cells and its eight immediate neighbours had to be examined, requiring no less than 622,080 iterations of the routine

	1	2	3		
	8	X	4		
	7	6	5		

Figure 1. The central cell, marked X, is tested by examining the eight surrounding locations

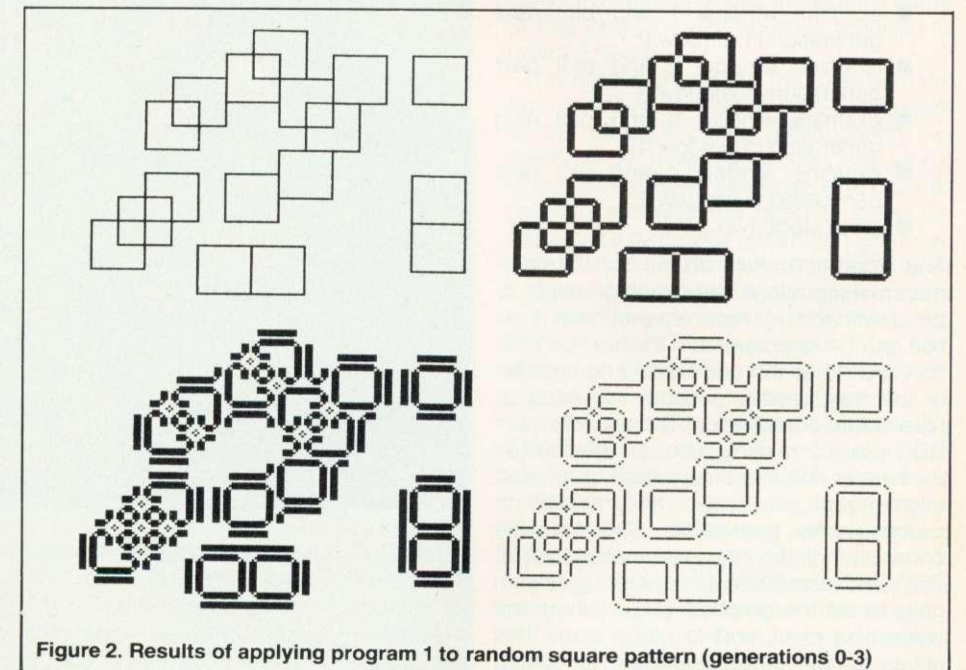


Figure 2. Results of applying program 1 to random square pattern (generations 0-3)

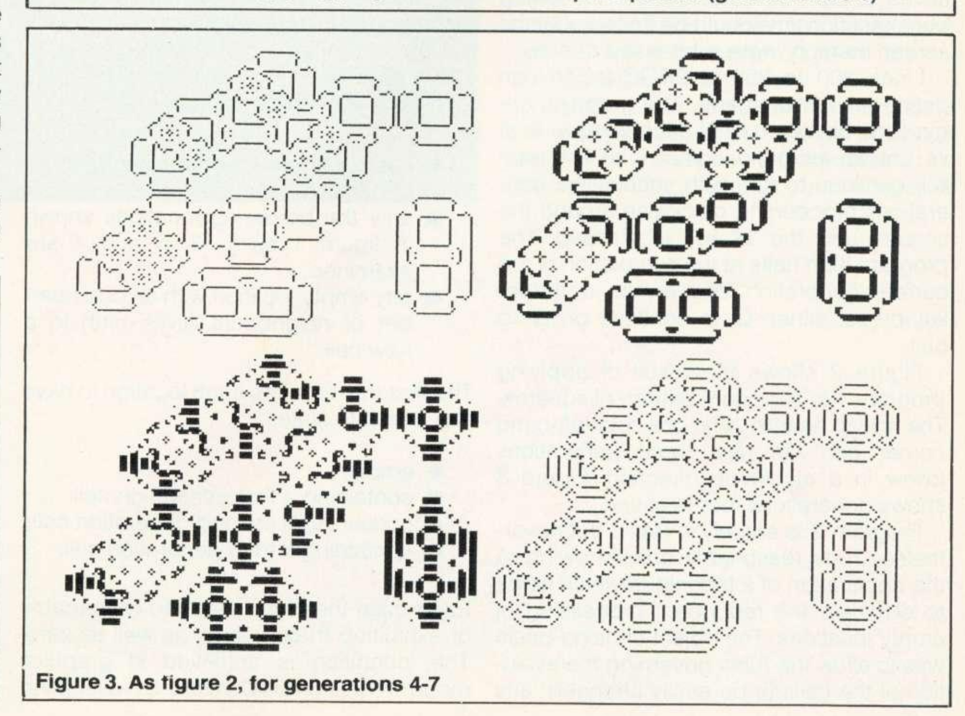


Figure 3. As figure 2, for generations 4-7

and probably taking several hours. Machine code speeded this up to about 18 minutes per generation.

A similar dual screen approach could have been used for the BBC micro because, although not a commonly used technique, the operating system does allow the re-mapping of screen memory so two separate screens can be generated and displayed. The approach used here is easier, and four or more generations can be viewed simultaneously. This makes it possible to follow the progress of a pattern without resorting to hard copy of each successive generation. In program 1, the screen is effectively divided into four separate windows, each having a resolution of 160 by 128. The program generates the following sequence of events:

- set up initial pattern in window 1;
- examine window 1 and plot next generation in window 2;
- examine window 2 and plot next generation in window 3;
- examine window 3 and plot next generation in window 4;
- examine window 4 and plot next generation in window 1;
- go to stage two.

This approach relies on the VDU29 command which allows the graphics origin to be redefined. This means a particular location can be examined and the next generation plotted at the corresponding location in the next window without the need to recalculate coordinates. The program is in BBC Basic, making use of the built-in assembler for the time-critical part, and takes about two and a half minutes to process one generation. The machine code part of the program makes use of OSWORD and OSWRCH operating system calls to set the graphics origin, return the value of a pixel, and to plot a pixel. This saves a considerable amount of coding but execution time could be improved if the screen memory were addressed directly.

Lines 300 to 350 of PROCdesign can define any initial shape. The graphics origin (coordinates 0,0) of each window is at its bottom left-hand corner. The program will continue to run, with successive generations proceeding clockwise around the screen, until the 'H' key is pressed. The program then halts at the completion of the current generation and awaits a further key-press: either 'C' to continue or 'Q' to quit.

Figure 2 shows the result of applying program 1 to a random pattern of squares. The initial pattern is in the top left-hand corner and the next three generations follow in a clockwise direction. Figure 3 shows generations four to seven.

Program 2 is entirely in Basic but nevertheless runs reasonably quickly owing to the application of a technique which helps to eliminate the redundant processing of empty locations. The object of using Basic was to allow the rules governing the evolution of the cells to be easily changed; any

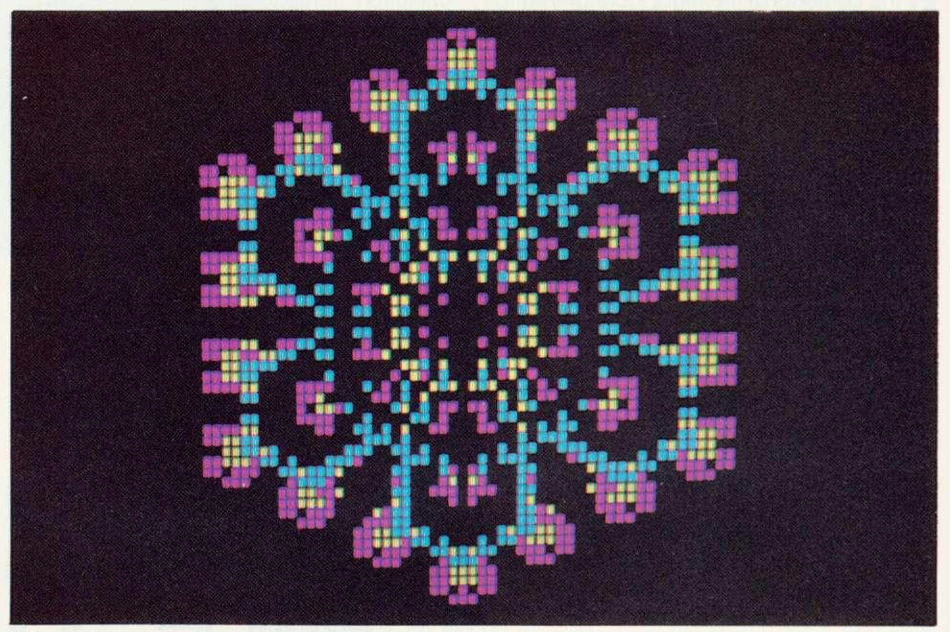


Figure 9.

potentially interesting combinations could then be incorporated into a program similar to the first listing. In this situation it is sufficient to process relatively small initial cell groups. The feature of being able to display several generations simultaneously has been retained, which makes it easier to see how a pattern is evolving. The rules incorporated in this program are:

- each cell survives for exactly three generations and then vanishes;
- only the bordering locations shown in figure 1 as 1, 3, 5 and 7 are examined;
- any empty location with an odd number of neighbours gives birth to a new cell.

The first rule requires each location to have four possible states:

- empty;
- containing a first generation cell;
- containing a second generation cell;
- containing a third generation cell.

Each pixel therefore needs to be capable of exhibiting three values as well as zero. This condition is achieved in graphics mode 1 on the BBC micro by assigning one of the four logical colours to each pixel to represent the state of each location.

When processing a single small shape, only those locations within the shape and immediately bordering it need be examined. This fact is used to optimise speed and allow the display of a large number of generations simultaneously. In effect, each window is made just big enough to accommodate the current generation. With most algorithms of this type, the overall shape tends to expand and so a larger area must be allotted to each successive generation. Consequently the time required to process each generation increases, but the overall saving in time is considerable.

Figure 4 shows the program applied to a single cell, while figure 5 starts with five cells arranged in the shape of a cross (if figure 1 is taken to represent the centre of the display grid, locations 2, 4, 6, 8 and the centre location would initially be occupied). In figure 5 the condition for the creation of a new cell is that there is just one neighbour. Line 30 sets logical colours 1, 2 and 3 appear as white for a monochrome display (leave out for a colour monitor). This has the advantage of giving a clear indication of the generation of each cell.

It is possible to explore the effects of

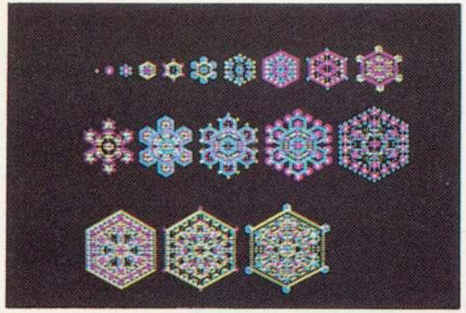
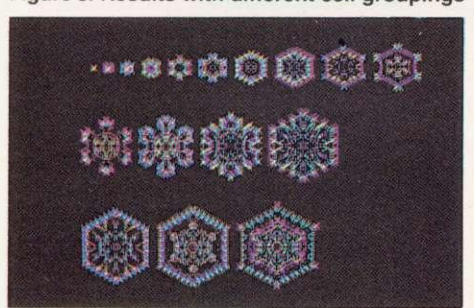


Figure 8. Results with different cell groupings



changing the rules and cell patterns by altering program 2. The variable, 'count%' holds the current number of neighbouring cells, 'colour' is the logical colour of the current generation and 'thiscell' is the logical colour of the current location. Line 290 defines the conditions for the creation of a cell and lines 190 and 200 determine the locations, relative to the current location, to be taken into account. As before, 'PROCdesign' can be altered to generate any desired initial configuration. In this case the graphics origin is at the centre of each window. If the initial cell group has a width or height greater than three pixels, the initial value of L% in line 40 (which determines the initial size of the window) will need to be increased to accommodate it. L% is automatically incremented as the program proceeds.

So far we have been concerned with cells on a rectangular grid. The next listing attempts to apply a set of rules in which the state of a location is determined by six of the neighbouring locations arranged in the hexagonal form (program 3). As the screen locations are arranged in a rectangular matrix, it is not possible to simulate a hexagonal grid perfectly, but a reasonable approximation can be achieved (figure 6). For each potential cell location, the relative locations 1 to 6 are examined. Figure 7 shows this is good enough to approximate hexagonal symmetry, and the first 18 generations are shown. As might be expected, many of the six-sided shapes are reminiscent of snowflakes. The initial pattern is a square block of nine cells. Again, each cell survives for three generations and the creation of a new cell is dependent on a location having an odd number of neighbours.

Figure 8 shows the same rules applied to slightly different cell groupings. The rules have also been changed in the third frame so that only one neighbour is required to create a new cell.

If a further change to the rules is made such that third generation cells are ignored for the purpose of the neighbouring cell count, it is possible to use the whole screen to display a single generation. This variation removes the need to leave the display of a particular generation unaltered while the next is being determined. Figure 9 shows generation 14 of such a display and was generated using program 4. The individual cells are represented by 3×3 blocks of pixels (as defined in PROCblock), giving an effective resolution of 80×64 and a larger display which is more suitable for the UHF input of a television receiver. The PAL television system is unable to give a satisfactory rendering of colour detail at the level of a single mode 1 pixel. Hence some colour detail will be lost if listing 3 is run into a domestic receiver rather than an RGB monitor. Once again, any initial pattern of blocks can be incorporated in the definition of PROCdesign. The initial value of L% in line 40 will need to be increased in increments of 16 to accommodate larger initial patterns.

I hope the examples given will stimulate further experimentation in the generation of patterns by the repeated applications of a few simple rules to various 'seed' shapes. ●

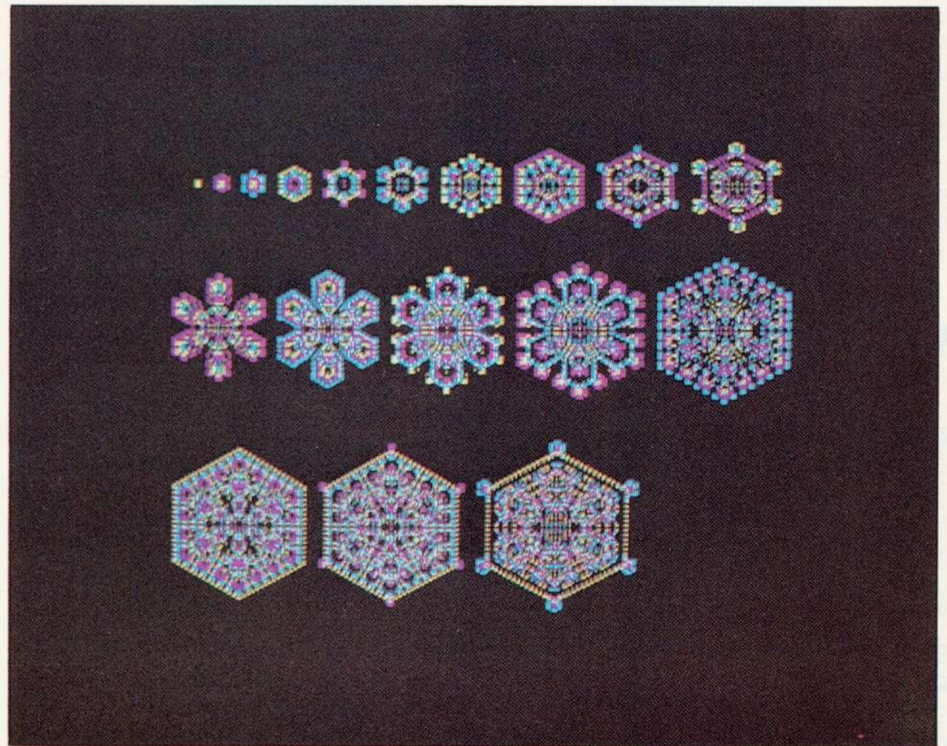


Figure 7. Approximate hexagonal symmetry

		2		
1				3
		x		
6				4
		5		

Figure 6. Hexagonal grid approximation

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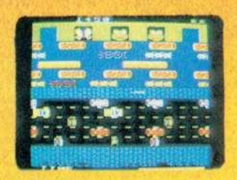
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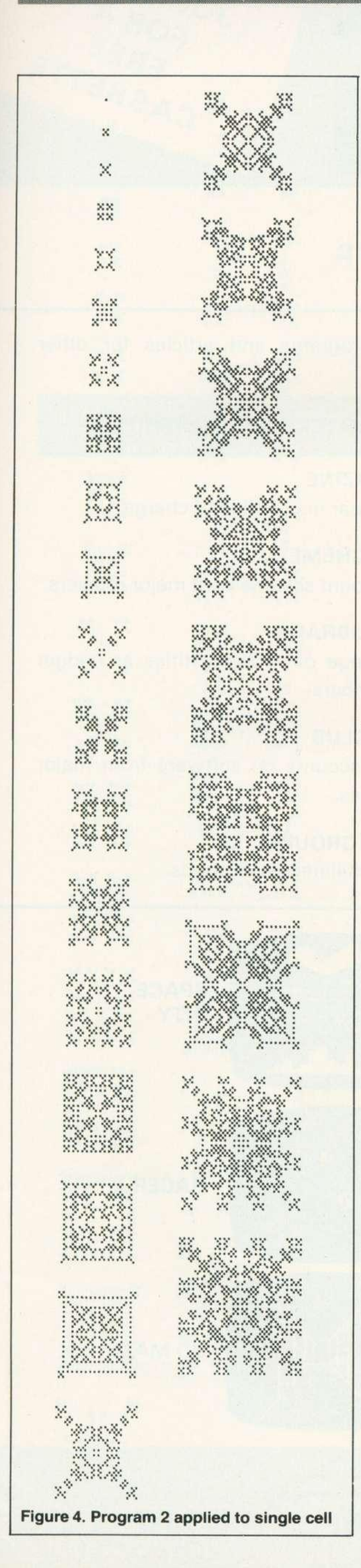


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Figure 4. Program 2 applied to single cell

```
   10 PROCassemble
   20 MODE4
   30 VDU29,0;512;
   40 PROCdesign
   50 REPEAT
   60 PROCsource(0,512):PROCdestination(
640,512)
   70 CALL life:PROCkey
   80 PROCsource(640,512):PROCdestinatio
n(640,0)
   90 CALL life:PROCkey
  100 PROCsource(640,0):PROCdestination(
0,0)
  110 CALL life:PROCkey
  120 PROCsource(0,0):PROCdestination(0,
512)
  130 CALL life:PROCkey
  140 UNTIL FALSE
  150 END
  160
  170
  180 DEF PROCsource(X%,Y%)
  190 ?SXL=X%MOD256:?SXH=X%DIV256
  200 ?SYL=Y%MOD256:?SYH=Y%DIV256
  210 ENDPROC
  220
  230
  240 DEF PROCdestination(X%,Y%)
  250 ?DXL=X%MOD256:?DXH=X%DIV256
  260 ?DYL=Y%MOD256:?DYH=Y%DIV256
  270 ENDPROC
  280
  290
  300 DEF PROCdesign
  310 FORI%=1TO20
  320 MOVERND(13)*40,RND(9)*40
  330 PLOT1,80,0:PLOT1,0,80:PLOT1,-80,0:
PLOT1,0,-80
  340 NEXT
  350 ENDPROC
  360
  370
  380 DEF PROCassemble
  390 osword=&FFF1:oswrch=&FFEE:pixel=&7
8:XO=&79:YO=&7A:colour=&85
  400 XBL=&70:XBH=&71:YBL=&72:YBH=&73:XL
=&74:XH=&75:YL=&76:YH=&77
  410 cellcount=&7B:thiscell=&84:SXL=&7C
:SXH=&7D:DXL=&7E:DXH=&7F
  420 SYL=&80:SYH=&81:DYL=&82:DYH=&83:TX
L=&86:TXH=&87:TYL=&88:TYH=&89
  430 DIM life 400
  440 FOR PASS=0 TO 3 STEP 3:P%=life
  450 [OPT PASS
  460        CLD:LDA#2:STA XBH:LDA#112:
STA XBL
  470 .loop4  LDA#1:STA YBH:LDA#240:STA
YBL
  480 .loop3  JSR source:JSR cell:JSR de
st:LDA#0:STA colour
```

Program 1. plots four generations

continued on page 77

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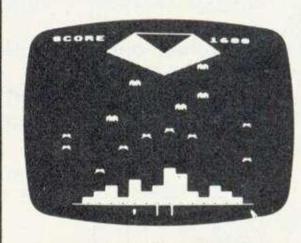
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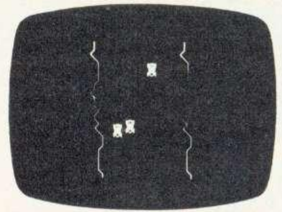
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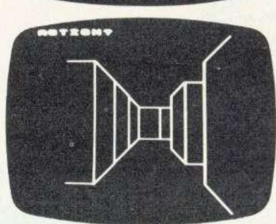
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Figure 5. Five-cell cross with program 2

► continued from page 75

```
  490          LDA thiscell:BEQ nocell:LD
A cellcount:CMP#2:BEQ newcell
  500 .nocell LDA cellcount:CMP#3:BNE sh
ow
  510 .newcell LDA#1:STA colour
  520 .show   LDA#18:JSR oswrch:LDA#0:JS
R oswrch:LDA colour:JSR oswrch
  530          JSR plot:SEC:LDA YBL:SBC#4
:STA YBL:CMP#252:BNE loop3
  540          LDA YBH:BEQ here:DEC YBH:J
MP loop3
  550 .here    SEC:LDA XBL:SBC#4:STA XBL:
CMP#252:BNE loop4
  560          LDA XBH:BEQ end:DEC XBH:JM
P loop4
  570 .end     RTS
  580 .cell    LDA#0:STA cellcount:LDA#12
:STA XO
  590 .loop2  LDA#12:STA YO:CLC:LDA XBL:
ADC XO:STA XL
  600          LDA XBH:STA XH:BCC loop1:I
NC XH
  610 .loop1  LDA YBL:ADC YO:STA YL:LDA
YBH:STA YH:BCC cont2:INC YH
  620 .cont2  LDY#0:LDX#XL
  630          LDA#9:JSR osword:LDA#8:CMP
 XO:BNE cont:CMP YO:BNE cont
  640          LDA pixel:STA thiscell:LDA
 XL:STA TXL:LDA XH:STA TXH
  650          LDA YL:STA TYL:LDA YH:STA
TYH:JMP cont1
  660 .cont    LDA pixel:BEQ cont1:INC ce
llcount
  670 .cont1  SEC:LDA YO:SBC#4:STA YO:BN
E loop1
  680          SEC:LDA XO:SBC#4:STA XO:BN
E loop2:RTS
  690 .dest    LDA#29:JSR oswrch:LDA DXL:
JSR oswrch:LDA DXH:JSR oswrch
  700          LDA DYL:JSR oswrch:LDA DYH
:JSR oswrch:RTS
  710 .source LDA#29:JSR oswrch:LDA SXL:
JSR oswrch:LDA SXH:JSR oswrch
  720          LDA SYL:JSR oswrch:LDA SYH
:JSR oswrch:RTS
  730 .plot    LDA#25:JSR oswrch:LDA#69:J
SR oswrch:LDA TXL:JSR oswrch
  740          LDA TXH:JSR oswrch:LDA TYL
:JSR oswrch:LDA TYH:JSR oswrch:RTS:]
  750 NEXT:ENDPROC
  760
  770
  780 DEF PROCkey
  790 A$=INKEY$(0)
  800 IF A$="H" REPEAT A$=GET$: UNTIL A$
="C" OR A$="Q"
  810 IF A$="Q" END
  820 ENDPROC
```

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BATTLE PLAN

Fresh from his defence of the cities from missile onslaught, Simon Williams tells in this extract from his Defencecom memoirs how he set the enemy up using Basic tactics

WHILE developing a games program in Basic for my BBC micro, I thought it might be useful to keep track of the stages of development to see how the finished game came about.

The game in question, Defencecom, is of the Missile Command type, although the finished product bears only passing resemblance to the arcade original. The final program is written entirely in Basic without recourse to indirection operators, so if you've invested in a second processor, you'll be delighted to learn that it should still run via the Tube.

The first step was to develop short, dummy-run programs to reproduce key aspects of the game. These checked from the start that the speed available from BBC Basic was sufficient to ensure that the completed game would be a challenge to play. These short programs developed into procedures used in Defencecom.

PROCmissiles is used to advance the incoming missiles. It consists of a loop which DRAWS a small section of each line in turn to build up the tracks of the missiles. The x and y coordinates of the tracks at any time are calculated using proportions, as the start and finish points are known and the y coordinate is altered by a set amount in each loop.

It is important that as much calculation as possible is carried out before the start of the main game loop. This system seemed to work satisfactorily, although it is slightly amended within the final program.

PROCscreen sets up the backdrop of the game using a variety of different background colours. At this stage most of the user-defined graphics were worked out. This may seem early to be considering the niceties of the eventual screen image, but it normally ensures the game will be visually attractive.

PROCsights (line 5010) moves the defence missile sights around the screen. This program should surprise nobody as it makes use of simple INKEY statements, using negative parameters to ensure the machine scans the keyboard and not the keyboard buffer. This method means that the micro can detect more than one key depression on each pass of the control loop, making possible, for instance, diagonal movement around the screen.

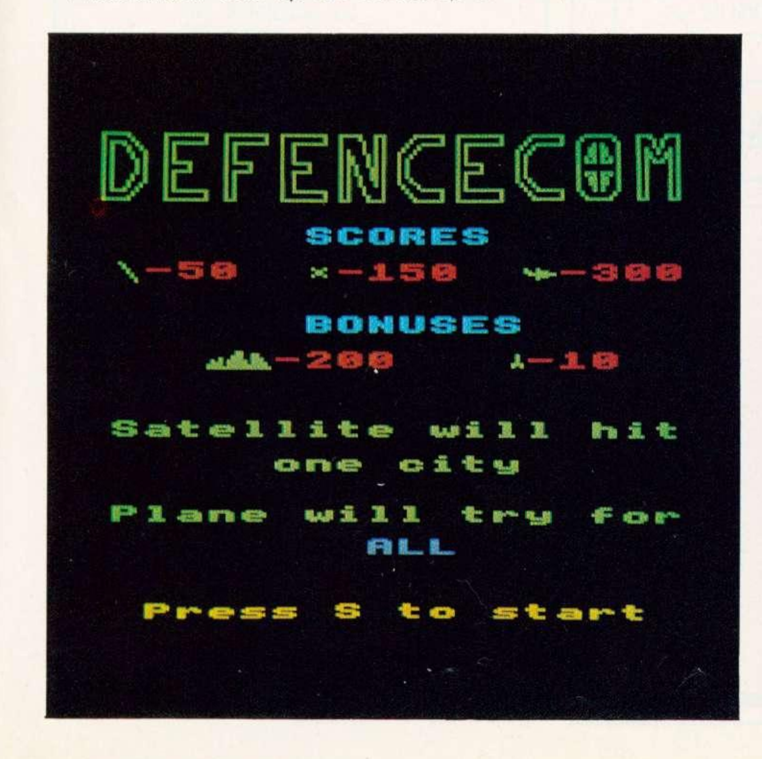
Having checked that the major elements of the program could be made to work, the next stage was to devise a main control loop to run the program.

To do this a flow chart, figure 1, was drawn up. This sequence of actions can be adapted to most video games. Whether it is Space Invaders, Pac-Man, Frogger or Missile Command, the progression of events is much the same and essentially simple. In a high-level language it is a straightforward step to translate this flow into the main control loops of the game itself.

Programs really are easier to follow if they don't involve the use of GOTO statements for loop control. For this reason a system of REPEAT. . .UNTIL loops and named procedures was employed with, as near as possible, the direct translation of the flow chart into the main control program. This can be seen in lines 10-180 of the final game listing 1.

Each procedure was programmed to perform a specific task within the game, and the titles of the procedures reflect these tasks. In some cases they call further procedures or levels of procedures and so build up a four-tier hierarchical structure. A brief run-through of the first level of called procedures and their actions should illustrate how the program is built up.

PROCinitialise dimensions arrays for the positions of incoming missiles (X3%(12) and Y3%(12)), the increments of their movement (DX%(12) and DY%(12)), and the x coordinates of the six cities (C%(6)). The various user-defined graphics are set up and allocated to strings for easier subsequent handling. Note that, in line 1110, the explosion string EX$ is drawn as a clockwise spiral, which gives a fairly realistic explosion. Variables which need to be set up for replays as well as for the first





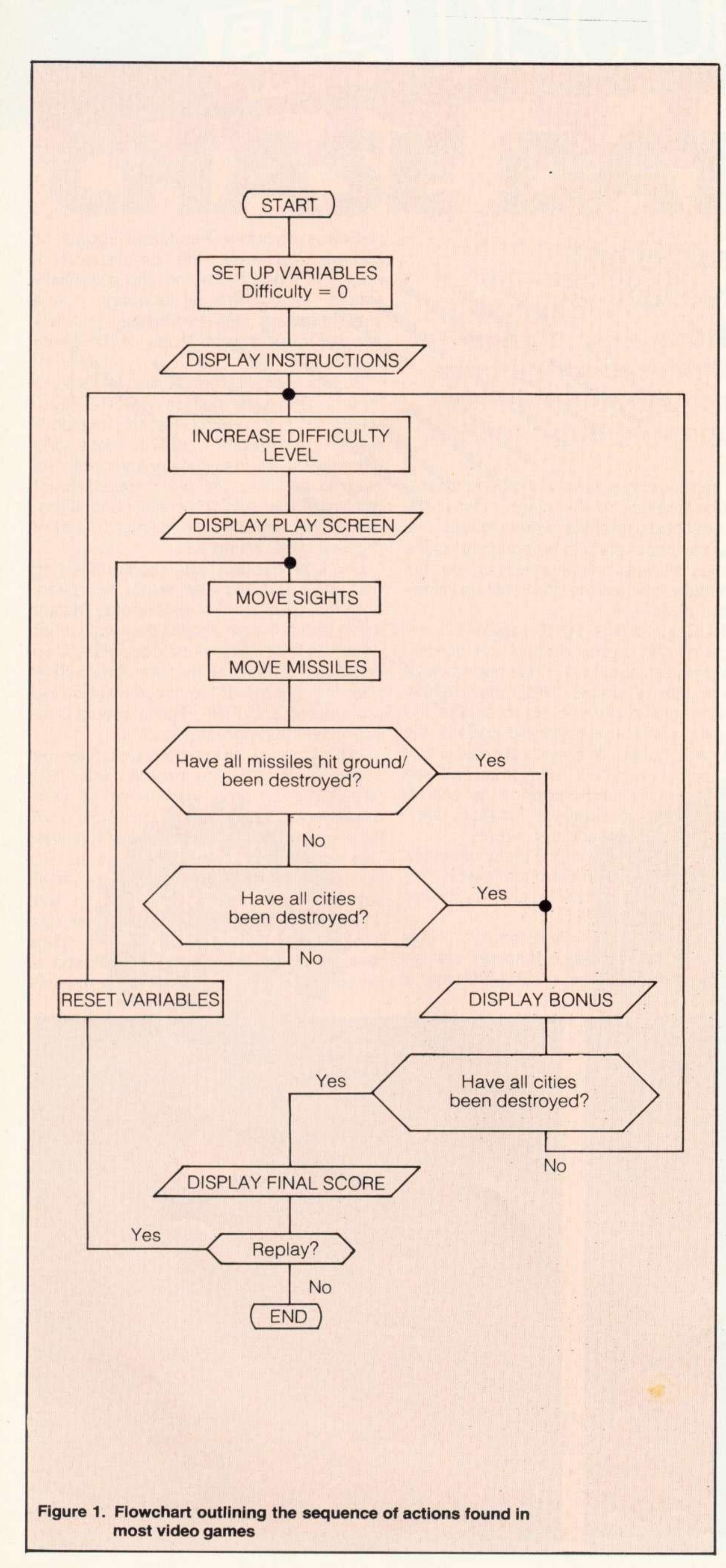


Figure 1. Flowchart outlining the sequence of actions found in most video games

INTEGERS

A%—Ammunition left
B%—Number of current background colour
C%—Cities left
D%—Duration of note in fanfare
DIF%—Current level of difficulty
DPX%—Movement increment for projectile
E%—Explosion delay counter
EX%—x coordinate of explosion
EY%—y coordinate of explosion
ENTRY%—Entry variable
F%—Frequency of note in fanfare
HS%—Current high score
L%—General-purpose loop counter
M%—Missiles in flight
N%—General purpose loop counter
NX%—New x coordinate for sights
NY%—New y coordinate for sights
NX3%—New x coordinate for current missile
NY3%—New y coordinate for current missile
P%—Projectile type/in flight flag
PCX%—x coordinate of next undestroyed city
PX%—Current projectile x coordinate
S%—Size of title
SC%—Current score
T%—Time delay parameter
TS%—Temporary score variable
TX%—x coordinate of title origin
TY%—y coordinate of title origin
X%—x coordinate of sights
Y%—y coordinate of sights
X1%—x coordinate of missile start
X2%—x coordinate of missile finish

FLOATING POINT

TX—Current x coordinate of title
TY—Current y coordinate of title

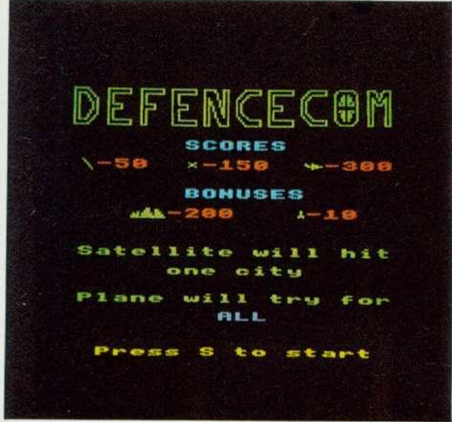
STRINGS

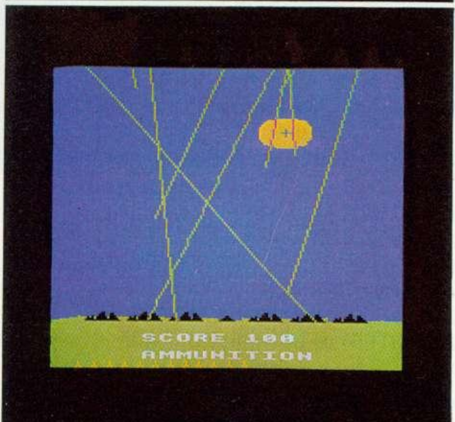
AMMO$—Ammunition graphics
B$—Bomber graphics
BASE$—DEFENCECOM base graphics
CITY$—city graphics
EX$—explosion graphics
P$—projectile graphics (B$ or SAT$)
SAT$—satellite graphics

ARRAYS

C%(6)—x coordinates of cities
DX%(12)—increment in missile x coordinates
DY%(12)—increment in missile y coordinates
X3%(12)—Current x coordinate of missiles
Y3%(12)—Current y coordinate of missiles

Figure 2. List of variables





playing of the game are devolved to PROCreset. The four sound envelopes are set up in lines 1130 to 1160.

PROCinstructions first calls PROCtitle, which draws the game's name, DEFENCECOM, in high-res graphics from x,y data pairs. The size and position of this title can be controlled via PROCtitle's parameters. PROCfanfare plays a short introductory tune and the first page of instructions is then displayed. This is followed by scores and bonuses, before the procedure exits and after input from the user, at line 2200.

PROClevel increases the level of difficulty, DIF%, and then uses this value to establish the rates of descent of incoming missiles. The values of flags P% and PX%, used by PROCprojectile, are then reset.

PROCscreen, as well as drawing the backdrop to the playscreen, also prints the score and remaining ammunition. B% is allocated the colour of the current background by reading it directly from the string "41367" in conjunction again with the level of difficulty variable, DIF%.

PROCsights incorporates line 6050, which calls PROCfire to set up an explosion. The conditional test for firing originally employed negative parameters to the INKEY statement, but because PROCmissiles takes a significant time to complete, the program would occasionally not respond to the space bar. By reading the keyboard buffer instead, the key will always operate, although sometimes after a short delay.

PROCmissiles includes several tests for hitting a defence missile, the ground or a city. The destruction of a city is handled separately by PROCcity, and satellite and plane attacks are also handled from this procedure by calling PROCprojectile.

PROCbonus calculates and displays the bonuses for cities saved at each level and for unused ammunition. It calls PROCpause, a parameter-driven delay loop.

PROCgameover handles the final screen display when all cities have been destroyed by missiles or plane or satellite fire. It requests input for a replay and, if necessary, calls PROCreset to reset variables.

At the lower level, PROCprojectile acts as a separate game by moving a satellite or plane across the screen to attack one or all cities. It calls respectively PROCsearch to establish the first eligible city for its attentions, and PROCshoot, which acts similarly to PROCcity.

The incorporation here of the systems of development may help you to produce games programs more easily, if not more quickly. It should make them easier to read and, if necessary to modify. I hope you enjoy playing Defencecom. ●

```
    1 REM DEFENCECOM by S.Williams
    2 REM Acorn User January 1984
    4
   10 MODE 2
   20 PROCinitialise
   30 PROCinstructions
   40 REPEAT
   50 REPEAT
   60 PROClevel
   70 PROCscreen
   80 REPEAT
   90 PROCsights
  100 PROCsights
  110 PROCmissiles
  120 PROCsights
  130 UNTIL M%=0 OR C%=0
  140 PROCbonus
  150 UNTIL C%=0
  160 PROCgameover
  170 UNTIL ENTRY%=78
  180 MODE 7
  190 END
  999
 1000 REM *** TO INITIALISE VARIABLES/
              USER CHARACTERS ETC
 1010 DEF PROCinitialise
 1020 DIM X3%(12),Y3%(12),DX%(12),DY%(12
),C%(6)
 1030 VDU 23,224,8,8,8,62,8,8,8,0,23,225
,0,0,0,24,24,60,126,255
 1040 VDU 23,226,1,1,3,19,87,119,247,255
,23,227,128,152;152,156,220,222,254,255
 1050 VDU 23,228,0,2,2,2,2,7,5,0,23,229,
0,0,144,220,127,28,16,0
 1060 VDU 23,230,0,0,36,24,24,36,0,0,23,
255,255,255,255,255,255,255,255,255
 1070 VDU 23,231,255,254,252,252,252,248
,192,192,23,232,255,127,127,63,63,15,1,0
 1080 VDU 23,233,1,15,31,63,63,127,127,2
55,23,234,192,248,252,252,254,254,255,25
5
 1090 S$=CHR$224: BASE$=CHR$225: CITY$=C
HR$226+CHR$227
 1100 AMMO$=CHR$228: B$=CHR$229: SAT$=CH
R$230
 1110 EX$=CHR$255+CHR$255+CHR$10+CHR$8+C
HR$231+CHR$8+CHR$8+CHR$255+CHR$8+CHR$8+C
HR$232+CHR$8+CHR$11+CHR$255+CHR$8+CHR$11
+CHR$233+CHR$255+CHR$234
 1120 PROCreset: HS%=0: VDU 23;8202;0;0;
0;
 1130 ENVELOPE 1,1,-50,5,5,1,12,12,127,0
,0,-127,126,126
 1140 ENVELOPE 2,1,20,-15,-15,6,3,3,127,
0,-2,-2,126,126
 1150 ENVELOPE 3,1,127,-2,-2,1,25,25,127
,0,0,-127,126,126
 1160 ENVELOPE 4,1,0,0,0,0,0,0,127,-1,-1
,0,126,50
 1170 ENDPROC
```

continued on page 83

continued from page 81

```
1999
2000REM *** TO DISPLAY INSTRUCTIONS
2010DEF PROCinstructions
2020FOR L%=50 TO 945 STEP 128
2030PROCtitle(50,L%,17)
2040NEXT: PROCfanfare
2050VDU 24,0;0;1270;815;: CLG: GCOL0,7
2060MOVE 32,500: PRINT"(c) 1983 S.Williams"
2070PROCpause(200): CLG: SOUND 1,3,0,100
2080VDU 4: COLOUR 9: COLOUR 128: PRINT TAB(2,7)"ALERT - HOSTILES"
2090COLOUR 2: PRINT TAB(2,10)"Destroy incoming"''"  missiles, planes"''"   and satellites"''" with ground to air"''"fire from DEFENCECOM"'" silo. Move sights:"
2100PRINT''"    A-up     Z-down"''"     <-left   >-right"''''"  Space bar-fire": COLOUR 3: PRINT''" Press S for scores";
2110REPEAT UNTIL GET=83: CLG
2120COLOUR 6: PRINT TAB(7,8)"SCORES" TAB(7,13)"BONUSES"
2130COLOUR 1: PRINT TAB(2,10)"-50    -150    -300" TAB(6,15)"-200      -10"
2140GCOL0,2: MOVE 80,700: DRAW 112,670
2150COLOUR 2: PRINT TAB(7,10);SAT$ TAB(14,10);B$ TAB(4,15);CITY$ TAB(13,15);AMMU$
2160PRINT TAB(1,19)"Satellite will hit" TAB(6,21)"one city"''''" Plane will try for"
2170COLOUR 11: PRINT TAB(9,26)"ALL"
2180COLOUR 3: PRINT TAB(2,30)"Press S to start";
2190REPEAT UNTIL GET=83: VDU 26,5: COLOUR 7: COLOUR 130
2200ENDPROC
2999
3000REM *** TO SET UP VARIABLES FOR                    NEXT LEVEL OF PLAY
3010DEF PROClevel
3020IF DIF%<5 DIF%=DIF%+1
3030FOR N%=1 TO 12
3040IF N%<6 X1%=80+(N%-1)*250+RND(40) ELSE X1%=RND(1279)
3050X2%=40+RND(7)*150
3060X3%(N%)=X1%: Y3%(N%)=1023
3070DY%(N%)=DIF%*3+RND(10)
3080DX%(N%)=(X1%-X2%)*-DY%(N%)/823
3090NEXT
3100E%=0: P%=0: PX%=-64
3110ENDPROC
3999
4000REM *** TO SET UP PLAY SCREEN
4010DEF PROCscreen
4020B%=VAL(MID$("41376",DIF%,1))+128: GCOL0,B%: CLG: GCOL0,2
4030FOR N%=0 TO 1280 STEP 100
4040MOVE N%,170+RND(20)
4050MOVE N%+100,170+RND(20)
4060PLOT 85,N%,0: PLOT 85,N%+100,0
4070NEXT: GCOL0,0: FOR N%=1 TO 6
4080IF C%(N%)>0 MOVE C%(N%),200: PRINT CITY$
4090NEXT: MOVE 608,200: PRINT BASE$
4100VDU 4: PRINT TAB(5,28)"SCORE ";SC% TAB(5,30)"AMMUNITION": VDU 5
4110GCOL0,3: FOR N%=1 TO A%
4120MOVE 55*N%,30: PRINT AMMO$
4130NEXT
4140X%=640: Y%=700: NX%=X%: NY%=Y%
4150GCOL3,7: MOVE X%,Y%: PRINT S$
4160ENDPROC
4999
5000REM *** TO MOVE SIGHTS AND PROCESS                    EXPLOSIONS
5010DEF PROCsights
5020IF A%=0 ENDPROC
5030NX%=X%-60*INKEY(-103)*(X%>127)+60*INKEY(-104)*(X%<1152)
5040NY%=Y%-60*INKEY(-98)*(Y%>270)+60*INKEY(-66)*(Y%<991)
5050IF INKEY(0)=32 PROCfire
5060GCOL3,7: MOVE X%,Y%: PRINT S$: MOVE NX%,NY%: PRINT S$
5070X%=NX%: Y%=NY%
5080IF E%=8 GCOL3,7: MOVE EX%,EY%: PRINT EX$: E%=0 ELSE IF E%>0 E%=E%+1
5090ENDPROC
5999
6000REM *** TO MOVE MISSILES AND OTHER                    PROJECTILES
```

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```
6010DEF PROCmissiles
6020N%=0: M%=0: GCOL0,2
6030REPEAT: N%=N%+1
6040IF Y3%(N%)=0 UNTIL N%=12: ENDPROC
6050NX3%=X3%(N%)+DX%(N%): NY3%=Y3%(N%)-DY%(N%)
6060IF POINT(NX3%,NY3%)=(7 EOR B%)-128 Y3%(N%)=0: SC%=SC%+50: VDU 4: PRINT TAB(
11,28);SC%: VDU 5: SOUND &11,1,200,2: UNTIL N%=12: ENDPROC
6070IF Y3%(N%)<180 PROCcity: Y3%(N%)=0: UNTIL N%=12: ENDPROC
6080MOVE X3%(N%),Y3%(N%): DRAW NX3%,NY3%: X3%(N%)=NX3%: Y3%(N%)=NY3%
6090M%=M%+1: UNTIL M%=5 OR N%=12
6100IF P%>0 PROCprojectile ELSE IF RND(30)<DIF%-1 PROCprojectile
6110ENDPROC
7000REM *** TO CALCULATE AND DISPLAY                                BONUS SCORE
7010DEF PROCbonus
7020CLG: PROCtitle(50,800,17)
7030GCOL0,8: MOVE 480,700: PRINT"BONUS"
7040GCOL3,7: MOVE 32,550: PRINT"CITIES": MOVE 160,450: PRINT"AMMO"
7050MOVE 352,300: PRINT"SCORE ";SC%: TS%=SC%
7060GCOL0,2: M%=316: FOR N%=1 TO 6
7070IF C%(N%)>0 M%=M%+136: MOVE M%,550: PRINT CITY$: SC%=SC%+200: SOUND 1,-12,3
0,5: PROCpause(30)
7080NEXT: GCOL3,7: MOVE 736,300: PRINT;TS%: MOVE 736,300: PRINT;SC%
7090TS%=SC%: GCOL0,2: M%=370: FOR N%=1 TO A%
7100IF A%>0 M%=M%+45: MOVE M%,450: PRINT AMMO$: SC%=SC%+10: SOUND 1,-12,50,2: P
ROCpause(20)
7110NEXT: GCOL3,7: MOVE 736,300: PRINT;TS%: MOVE 736,300: PRINT;SC%
7120A%=A%+12: IF A%>20 A%=20
7130PROCpause(300)
7140ENDPROC
7999
8000REM *** TO HANDLE END OF GAME/                                  REPLAY ETC
8010DEF PROCgameover
8020GCOL0,128: CLG: M%=611
8030FOR L%=5 TO 17 STEP 4
8040PROCtitle(50,M%,L%)
8050M%=M%+L%*7
8060NEXT: VDU 4: COLOUR 128: PROCfanfare
8070PRINT TAB(10,16)"GAME OVER"TAB(1,20)"Your score   ";SC% TAB(1,22)"High score
 ";HS%
8080COLOUR 3: PRINT TAB(1,29)"Another game?(Y/N)"
8090REPEAT: ENTRY%=GET: UNTIL ENTRY%=78 OR ENTRY%=89
8100IF SC%>HS% HS%=SC%
8110IF ENTRY%=89 PROCreset
8120ENDPROC
8999
9000REM *** TO SET/RESET INITIAL                                    VALUES
9010DEF PROCreset
9020C%(1)=126: C%(2)=276: C%(3)=426: C%(4)=726: C%(5)=876: C%(6)=1026
9030DIF%=0: C%=6: SC%=0: A%=20
9040COLOUR 7: COLOUR 130: VDU 5
9050ENDPROC
9999
10000REM *** TO DRAW GAME TITLE
10010DEF PROCtitle(TX%,TY%,S%)
10020RESTORE 10070: GCOL0,2: MOVE TX%,TY%
10030FOR N%=1 TO 139
10040READ TX,TY
10050IF TX<10 PLOT 1,TX*S%,TY*S% ELSE TX=TX-10: PLOT 0,TX*S%,TY*S%
10060NEXT
10070DATA 0,7,3,0,2,-2,0,-3,-2,-2,-3,0,11,1,0,5,1.5,0,1.5,-2,0,-1,-1.5,-2,-1.5,0
,16,-1,0,7,5,0,0,-1,-4,0,0,-2,2,0,0,-1,-2,0,0,-2,4,0,0,-1,-5,0
10080DATA 17,0,0,7,5,0,0,-1,-4,0,0,-2,2,0,0,-1,-2,0,0,-2,4,0,0,-1,-5,0
-4,0,0,-2,2,0,0,-1,-2,0,0,-3,-1,0,17,0,0,7,5,0,0,-1,
10090DATA 17,0,0,7,2,0,2,-5.5,0,5.5,1,0,0,-7,-2,0,-2,5.5,0,-5.5,-1,0,17,2,0,3,2,
2,3,0,0,-1,-2.5,0,-1.5,-1.5,0,-2,1.5,-1.5,2.5,0,0,-1,-3,0,-2,2
10100DATA 17,-2,0,7,5,0,0,-1,-4,0,0,-2,2,0,0,-1,-2,0,0,-2,4,0,0,-1,-5,0,17,2,0,3
,2,2,3,0,0,-1,-2.5,0,-1.5,-1.5,0,-2,1.5,-1.5,2.5,0,0,-1,-3,0,-2,2
```

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YOUR PARENTS DID THEIR BEST FOR YOU...WILL YOUR CHILDREN BE ABLE TO SAY THE SAME?



"Now...I've got two oranges in my left hand and one in my right, how many oranges...?"

IN THE LAST FIVE YEARS, THE MICROCHIP HAS EXTENDED ITS REVOLUTIONISING INFLUENCE TO OUR SCHOOLS. TODAY, EVEN THE YOUNGEST CLASSES TAKE COMPUTERS AS MUCH FOR GRANTED AS WE DID OUR WOODEN RULERS.

WITH THESE IMPLICATIONS IN MIND, GOOD HOUSEKEEPING SOFTWARE WAS CREATED; ITS AIM BEING TO DEVELOP A COMPREHENSIVE RANGE OF CAREFULLY STRUCTURED EARLY LEARNING SOFTWARE FOR YOUR HOME COMPUTER.

A NEW WAY TO PLAY AND LEARN

DESIGNED NOT JUST BY SOFTWARE SPECIALISTS, BUT ALSO BY EDUCATIONAL EXPERTS, EACH PACKAGE GOES FAR BEYOND THE POPULAR IMAGE OF COMPUTER ASSISTED LEARNING.

IT PROVIDES A FRAMEWORK FOR YOU AND YOUR CHILD TO LEARN AND PLAY TOGETHER. IT ALSO ENCOURAGES YOUR CHILD TO DISCOVER THE REWARDS OF INDEPENDENCE AND CONCENTRATION AS HE OR SHE EXPLORES THE PROGRAM ALONE, OR WITH A FRIEND.

EACH PACKAGE INCLUDES GAMES. BUT UNLIKE MOST OTHER SOFTWARE FOR CHILDREN, THESE ARE NEITHER TRIVIAL NOR COMPETITIVE. THEY ARE DESIGNED TO ENCOURAGE LEARNING THROUGH STRUCTURED PLAY, COLOURFUL EYE-CATCHING GRAPHICS OF THE HIGHEST QUALITY, AND A VARIETY OF REALISTIC SOUND EFFECTS.

YOU CAN ALSO ADJUST THE SPEED AND DIFFICULTY OF EACH GAME TO SUIT YOUR CHILD. OR LET THE COMPUTER ADJUST ITSELF AUTOMATICALLY AS YOUR CHILD PROGRESSES.

LEARNING WITH MR T

MR T, GOOD HOUSEKEEPING'S LIVELY ANIMATED CHARACTER, WILL HELP YOUR CHILDREN EXPLORE ALL SORTS OF PREVIOUSLY DIFFICULT EDUCATIONAL AREAS. NOW THEY CAN LEARN TO TELL THE TIME, OR COPE WITH REAL MONEY, IN AN EXCITING AND ENTERTAINING WAY.

MR T WILL ALSO HELP YOUR CHILDREN COME TO TERMS WITH THE WHOLE IDEA OF COMPUTERS AS AN INTEGRAL PART OF THEIR FUTURE LIVES.

THE PARENTS' HANDBOOK

A PARENTS' HANDBOOK IS INCLUDED IN EACH PACKAGE, CONTAINING SIMPLE OPERATING INSTRUCTIONS AND A STEP-BY-STEP GUIDE TO HELP YOU AND YOUR CHILD GET THE BEST OUT OF EACH PROGRAM. IT ALSO CONTAINS A WEALTH OF FOLLOW-UP ACTIVITIES FOR YOU BOTH TO ENJOY AWAY FROM THE COMPUTER.

YOUR CHILDREN'S FUTURE BEGINS HERE

PUT YOUR HOME COMPUTER TO WORK FOR YOUR CHILDREN NOW. SEND FOR YOUR GOOD HOUSEKEEPING EARLY LEARNING PACKAGES BY CUTTING THIS COUPON.

HARDWARE COMPATIBILITY: BBC MICRO B (O.S 1.0 OR ABOVE)
SINCLAIR SPECTRUM 48K, COMMODORE 64.
AVAILABLE AT LEADING COMPUTER STORES AND SPECIALIST COMPUTER DEPARTMENTS OF MAJOR HIGH STREET RETAILERS.

TO: EBURY SOFTWARE, 72 BROADWICK STREET, LONDON W1V 2BP.
PLEASE SEND ME THE GOOD HOUSEKEEPING SOFTWARE PACKAGE(S) THAT I HAVE INDICATED.

		BBC MICRO B (O.S. 1.0 OR ABOVE)	SINCLAIR SPECTRUM 48K
MR T TELLS THE TIME	£12.95 EACH		
MR T'S MONEY BOX	£12.95 EACH		
MR T'S ALPHABET GAMES	£12.95 EACH		AVAILABLE 1984
MR T'S NUMBER GAMES	£12.95 EACH		
MR T'S MEASURING GAMES	£12.95 EACH		
MR T'S SHAPE GAMES	£12.95 EACH		
	TOTAL		

COMMODORE 64, VERSIONS AVAILABLE 1984.

I ENCLOSE MY CHEQUE/PO FOR THE AMOUNT ABOVE INCLUDING VAT AND P&P, MADE PAYABLE TO EBURY SOFTWARE OR CHARGE MY ACCESS/VISA/DINERS/AMERICAN EXPRESS

A/C NO. ________

SIGNED ________ DATE ________

NAME MR/MRS/MS ________
(BLOCK LETTERS)

ADDRESS ________

TOTAL NUMBER OF PACKAGES ORDERED ________

REMITTANCE SHOULD BE MADE PAYABLE TO EBURY SOFTWARE AND SHALL BE HELD ON YO[UR] BEHALF IN THIS ACCOUNT UNTIL THE GOODS ARE DESPATCHED. PLEASE ALLOW UP TO 2[8] DAYS FOR DELIVERY. OFFER APPLIES TO U.K. AND EIRE ONLY.
EBURY SOFTWARE (A DIVISION OF THE NATIONAL MAGAZINE CO LTD).
REGISTERED NUMBER: 112955.

GOOD HOUSEKEEPING SOFTWARE · EARLY LEARNING

PUBLISHED BY EBURY SOFTWARE (A DIVISION OF THE NATIONAL MAGAZINE CO LTD) FOR GOOD HOUSEKEEPING, NATIONAL MAGAZINE HOUSE, 72 BROADWICK STREET, LONDON W1V 2BP.

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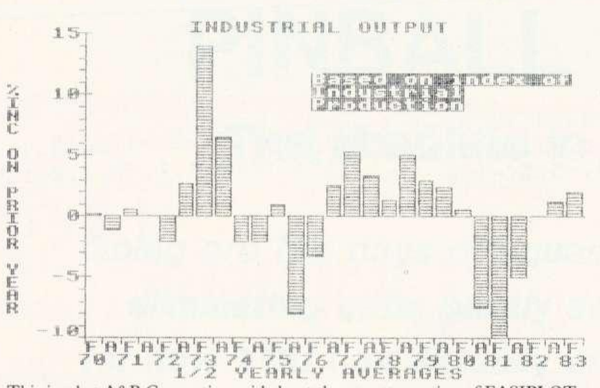
```
10110DATA 17,-1,0,5,1,1,3,0,1,-1,0,-5,-1,-1,-3,0,-1,1,11,2,1,0,0,-2,-1,2,10,1,1,
2,0,-2,-1,0,12,0,0,2,1,-2,-1,0,10,-1,1,0,-1,-2,0,2,14,-3,0,7,1.5,0,1,-2,1,2,1.5,
0,0,-7,-1,0,0,5.5,-1,-1.5,-1,0,-1,1.5,0,-5.5,-1,0
10120ENDPROC
10999
11000REM *** TO PLAY FANFARE
11010DEF PROCfanfare
11020RESTORE 11060: FOR N%=1 TO 15
11030READ F%,D%
11040SOUND 1,-15,F%,D%: SOUND 1,0,1,1
11050NEXT
11060DATA 33,1,33,1,53,2,49,1,53,1,61,2,53,1,61,1,69,2,61,1,53,1,49,2,41,1,49,1,
53,4
11070ENDPROC
11999
12000REM *** TO DESTROY CITY/BASE ON MISSILE HIT
12010DEF PROCcity
12020GCOL3,8: FOR L%=1 TO 6
12030IF C%(L%)>0 AND X3%(N%)>C%(L%) AND X3%(N%)<C%(L%)+128 MOVE C%(L%),200: PRIN
T CITY$: C%(L%)=0: C%=C%-1: SOUND &12,2,50,20
12040NEXT
12050IF X3%(N%)>608 AND X3%(N%)<672 MOVE 608,200: PRINT BASE$: GCOL0,2: FOR L%=A
% TO 1 STEP -1: MOVE 55*L%,30: PRINT AMMO$: NEXT: A%=0: SOUND &11,3,0,10
12060ENDPROC
12999
13000REM *** TO MOVE SATELLITE/BOMBER
13010DEF PROCprojectile
13020IF P%=0 AND RND(6)>DIF% P%=1: P$=SAT$: DPX%=DIF%*10: PY%=RND(400)+600: PROC
search ELSE IF P%=0 P%=2: P$=B$: DPX%=DIF%*8: PY%=RND(200)+800: PROCsearch
13030IF PX%>1279 P%=0: PX%=-64: ENDPROC
13040IF PX%>PCX% PROCshoot
13050IF POINT(PX%+64,PY%-16)=(7 EOR B%)-128 GCOL3,1: MOVE PX%,PY%: PRINT P$: SOU
ND&11,1,200,5: SC%=SC%+150*P%: VDU 4: PRINT TAB(11,28);SC%: VDU 5: P%=0: PX%=-64
: ENDPROC
13060GCOL3,1: MOVE PX%,PY%: PRINT P$: PX%=PX%+DPX%
13070MOVE PX%,PY%: PRINT P$
13080ENDPROC
13999
14000REM *** TO FIRE DEFENCE MISSILES AND SET UP EXPLOSIONS
14010DEF PROCfire
14020IF E%=0 EX%=X%: EY%=Y%: GCOL 3,7: MOVE 640,240: DRAW X%,Y%: MOVE 640,240: D
RAW X%,Y%: PRINT EX$: SOUND &10,4,6,40: E%=1: GCOL0,2: MOVE 55*A%,30: PRINT AMMO
$: A%=A%-1
14030ENDPROC
14999
15000REM *** TO DELAY EXECUTION FOR SET TIME
15010DEF PROCpause(T%)
15020TIME=0: REPEAT UNTIL TIME>T%
15030ENDPROC
15999
16000REM *** TO SELECT CITY/IES FOR ATTACK
16010DEF PROCsearch
16020PCX%=1280: N%=1: REPEAT
16030IF C%(N%)>0 PCX%=C%(N%): PC%=N%
16040N%=N%+1
16050UNTIL N%=7 OR PCX%<1280
16060ENDPROC
17000REM *** TO SHOOT/DESTROY CITY
17010DEF PROCshoot
17020GCOL3,3: MOVE PX%+32,PY%-16: DRAW PX%+32,200: MOVE PX%+32,PY%-16: DRAW PX%+
32,200
17030GCOL0,8: MOVE PCX%,200: PRINT CITY$: IF C%(PC%)>0 C%(PC%)=0: C%=C%-1: SOUND
 &12,2,50,20
17040IF P%=2 PROCsearch ELSE PCX%=1280
17050ENDPROC
```

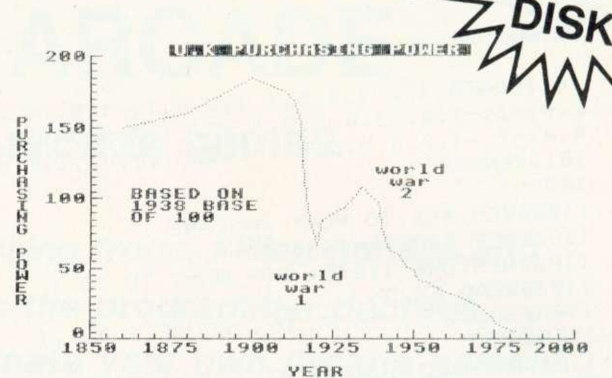
End of Defencecom Listing

EASIPLOT

'The professional graph program for the BBC Micro' (Model B only)

NOW ON DISK





This is what A&B Computing said about the cassette version of EASIPLOT (December 83 issue):-

"EASIPLOT . . has many options . . its very easy to use yet very comprehensive and very useful to people from small businesses to schools etc . . in conclusion this is a very good package . . Ratings . . value for money 85% . . overall 92%."

NOW EASIPLOT is on DISK and is EVEN MORE POWERFUL with extra facilities and an additional program, DATA PLOTTER (a share price/general purpose indicator program with selectable moving average curve, colour select and graph magnification facilities).

At a price of £19.95 the disk version must represent EXCEPTIONAL value for money!

FACILITIES:-

EASIPLOT 1 (CASSETTE ONLY) . . 3 comprehensive programs . . LINES, BARS & PIES—3 simultaneous graphs per program—AUTOMATIC or MANUAL scaling, sort and labelling—Full cassette save, load and cat options—100 characters of fixed description per graph—Choice of 10 different line types, 5 different bars—8 different colour combinations—Full EDIT and MERGE capabilities—GRID option—SCREENSAVE facility—Powerful OVERWRITE Mode—MENU driven—COMPREHENSIVE 40 PAGE MANUAL—Machine code screen dumps for EPSON (entire range), SHINWA (CP80) and SEIKOSHA (GP 100A & GP 80A) printers.

EASIPLOT 2 (DISK ONLY) . . additional facilities include—single and selectable file handling—scatter charts—5 mergeable graphs—powerful overwrite memory—bar/line interchanges—up to 200 chars of fixed description per graph and DATA PLOTTER (see above).

EASIPLOT is useful, educational and is also ideal for householders and investors.

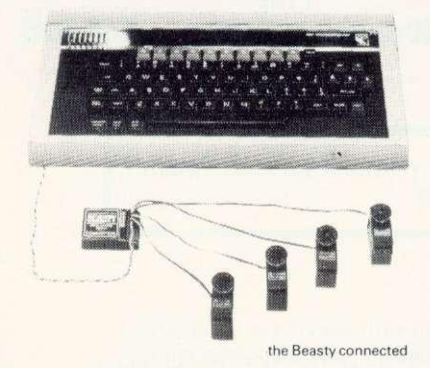
We are convinced that this is by far the best BBC graph package available . . . If after using EASIPLOT you do not agree, we will refund your money.

EASIPLOT is guaranteed for 12 months and programs are normally despatched within 24 hours of receipt of order.

Send remittance for £15.95 *(cassette version)* or £19.95 *(disk version-40 track) to*
SYNERGY SOFTWARE, Dept AU, 7 St Andrews Close, Slip End, Luton LU1 4DE.



What is the "Beasty"?



the Beasty connected

The Beasty is the interface which connects directly into the BBC microcomputer and enables the computer to accurately control up to four servos. The Beasty comes complete with all connection cables, a demonstration program and comprehensive instructions.

What is a Servo?

A servo is a precision geared motor with a feed back mechanism to give positional information. The servo rotates an output arm through 100° and allows you to twist, turn, push, pull, lift, lower, open, close almost anything.

The standard servo is a FP-S128, which develops 3.5Kg/cm torque with 100° range. There is also a range of servos available for almost any application.



the Beasty with the FP-S128

How Many Servos Do I Need?

You can start with **just one** and buy more as you need them. A Beasty can run up to four servos. All you have to do is decide on your movement requirements and select the number of servos you need.

Which Micro Do I Need?

The Beasty is designed for a BBC Model B microcomputer, (though a 32K Model A with a user port upgrade will suffice) fitted with OS Version 1.0 or above. Most of the Futaba range of servos can be driven from the 5v 1.25A DC auxiliary power output from the BBC microcomputer, though the more powerful ones may require an external power supply.

What About the Software?

The Beasty is supplied with a demonstration program on tape which allows sophisticated control of up to four servos directly from the keyboard. For those who wish to program the servos, the machine code driver occupies less than 256 bytes of relocatable code (so it can be stored at any location in RAM). From BASIC, instructions are of the form:

```
X% = Channelnum: Y% = Newvalue: CALL Driver
```

From Assembler, it's equally straightforward:

```
LDX 4          ; Servo number 4, for example
LDY NEWVAL%    ; Newval% is the new position
                 (between 0-255)
JSR DRIVER     ; Call Driver routine
```

More Details?



241 Green Street, Enfield, Middx. EN3 7SJ Tel: 01 804 1378

Your introduction to Microrobotics

► continued from page 77

```
10 MODE1
20 VDU29,64;900;:C%=64:D%=900
30 VDU19,1,3;0;19,2,5;0;19,3,6;0;
40 C=2:colour=3:L%=12
50 PROCdesign
60 ROW=1:A%=108:B%=900
70 REPEAT
80 L%=L%+8:C=C+1:colour=C MOD3+1
90 PROCmain(C%,D%,A%,B%)
100 C%=A%:D%=B%:A%=A%+2*L%+20
110 IF A%+2*L%>1270 A%=L%+20:B%=B%-2*L%-72:ROW=ROW+1
120 UNTIL ROW=4
130 END
135
140 DEF PROCmain(SX,SY,DX,DY)
150 VDU29,SX;SY;
160 FOR X%=-L% TO L% STEP 4
170 FOR Y%=-L% TO L% STEP 4
180 count%=0
190 FOR x%=X%-8 TO X%+8 STEP 16
200 FOR y%=Y%-4 TO Y%+4 STEP 8
210 IF POINT(x%,y%)>0 count%=count%+1
220 NEXT
230 NEXT
240 FOR y%=Y%-8 TO Y%+8 STEP 16
250 IF POINT(X%,y%)>0 count%=count%+1
260 NEXT
270 thiscell=POINT(X%,Y%)
280 IF thiscell>0 THEN IF thiscell<>colour PROCplot(thiscell)
290 IF thiscell=0 THEN IF count%MOD2=1 PROCplot(colour)
300 NEXT
310 NEXT
320 ENDPROC
325
330 DEF PROCplot(C) GCOL0,C
340 VDU29,DX;DY;:PLOT69,X%,Y%:VDU29,SX;SY;
345
350 ENDPROC
360 DEF PROCdesign
370 MOVE-4,-4:PLOT0,8,0:PLOT81,-8,8:PLOT81,8,0
380 ENDPROC
```

Program 2. Neglects empty locations

```
10 MODE1
20 VDU29,64;900;:C%=64:D%=900
30 VDU19,1,7;0;19,2,7;0;19,3,7;0;
40 C=2:colour=3:L%=12
50 PROCdesign
60 ROW=1:A%=108:B%=900
70 REPEAT
80 L%=L%+8:C=C+1:colour=C MOD3+1
90 PROCmain(C%,D%,A%,B%)
100 C%=A%:D%=B%:A%=A%+2*L%+20
110 IF A%+2*L%>1270 A%=L%+20:B%=B%-2*L%-72:ROW=ROW+1
120 UNTIL ROW=4
130 END
135
140 DEF PROCmain(SX,SY,DX,DY)
150 VDU29,SX;SY;
160 FOR X%=-L% TO L% STEP 4
170 FOR Y%=-L% TO L% STEP 4
180 count%=0
190 FOR x%=X%-4 TO X%+4 STEP 8
200 FOR y%=Y%-4 TO Y%+4 STEP 8
210 IF POINT(x%,y%)>0 count%=count%+1
220 NEXT
230 NEXT
270 thiscell=POINT(X%,Y%)
280 IF thiscell>0 THEN IF thiscell<>colour PROCplot(thiscell)
290 IF thiscell=0 THEN IF count%MOD2=1 PROCplot(colour)
300 NEXT
310 NEXT
320 ENDPROC
325
330 DEF PROCplot(C) GCOL0,C
340 VDU29,DX;DY;:PLOT69,X%,Y%:VDU29,SX;SY;
345
350 ENDPROC
360 DEF PROCdesign
370 PLOT69,0,0
380 ENDPROC
```

Program 3. Hexagonal variation

```
10 MODE1
20 VDU19,1,3;0;19,2,5;0;19,3,6;0;
30 VDU29,640;512;
40 C=2:colour=3:L%=64:G=1
50 PROCdesign
60 REPEAT G=G+1:VDU30:PRINT"generation ";G
70 C=C+1:colour=C MOD3+1
80 PROCmain : L%=L%+32
90 UNTIL FALSE
100 END
105
110 DEF PROCmain
120 FOR X%=-L% TO L% STEP 16
130 FOR Y%=-L% TO L% STEP 16
140 count%=0
150 FOR x%=X%-32 TO X%+32 STEP 64
160 FOR y%=Y%-16 TO Y%+16 STEP 32
170 P%=POINT(x%,y%):IF P%<>colour AND P%>0 count%=count%+1
180 NEXT
190 NEXT
200 FOR y%=Y%-32 TO Y%+32 STEP 64
210 P%=POINT(X%,y%):IF P%<>colour AND P%>0 count%=count%+1
220 NEXT
230 thiscell=POINT(X%,Y%)
240 IF thiscell = colour  GCOL0,0:PROCblock(X%,Y%)
250 IF count% MOD2=1 AND thiscell=0 GCOL0,colour:PROCblock(X%,Y%)
260 NEXT
270 NEXT
280 ENDPROC
285
290 DEF PROCblock(X,Y)
300 MOVEX-4,Y-4:PLOT0,8,0:PLOT81,-8,8:PLOT81,8,0
310 ENDPROC
315
320 DEF PROCdesign
330 FOR X%=-16 TO 16 STEP 16
340 FOR Y%=-16 TO 16 STEP 16
350 PROCblock(X%,Y%)
360 NEXT
370 NEXT
380 ENDPROC
```

Program 4. One generation displayed

THE TRAIN GAME

Peter Balch challenges you to enroll for his crash course in running a railway network

WRITING action-packed arcade games in Basic poses problems – objects have to move fast, you want lots to be happening and to know when things collide.

Machine code gives plenty of time to do all the calculations, but Basic runs a hundred or more times slower and is bulkier into the bargain. So you're limited in both time and space.

The suggestions in the BBC *User Guide* help, but not a great deal. Deleting REMs relieves the space problem, of course, as does putting several statements on one line and keeping identifiers short. Watch out for trailing blanks at the end of lines – they don't show on the listing but can add a few hundred bytes to a long program. However, all these 'improvements' are at the expense of readability. And neither they nor using integer variables help much with speed. The Basic interpreter is spending most of its time working out what the line means.

One solution is to have lots of 'active' objects, but few moving at any time. A pinball simulation is a good example. You can have lots of active objects – the ball, bumpers, flippers and so on – but only the ball is constantly moving. In The Train Game we have lots of points, passengers and trains waiting in the engine shed, but only four trains are allowed on the track at once.

Next, don't print characters at the graphics cursor (VDU 5) or use plotting, as both are very slow. For speed, use nothing but characters printed in the normal character locations.

Finally, there's the problem of knowing whether two objects have collided. You could search a table of object locations to see whether they have come close, but that would take forever. Similarly, using the POINT command is slow. Instead, keep a separate 'map' of the screen in an array. Every time you move an object into a new square you can look at the map to see if the square is occupied. A total of 1,280 integers (40 × 25 characters in mode 1) is a lot of bytes so you can't use an array. But you can use a byte for each character by declaring, for instance,

DIM board 1280

Then you can access each byte by, for instance,

board ? (row * 40 + column)

But remember that the interpreter doesn't check that (row * 40 + column) is within the bytes called 'board' – it's quite easy to overwrite your Basic program and lose it if your program has bugs. It's best to use a single function which works out

board + row * 80 + column

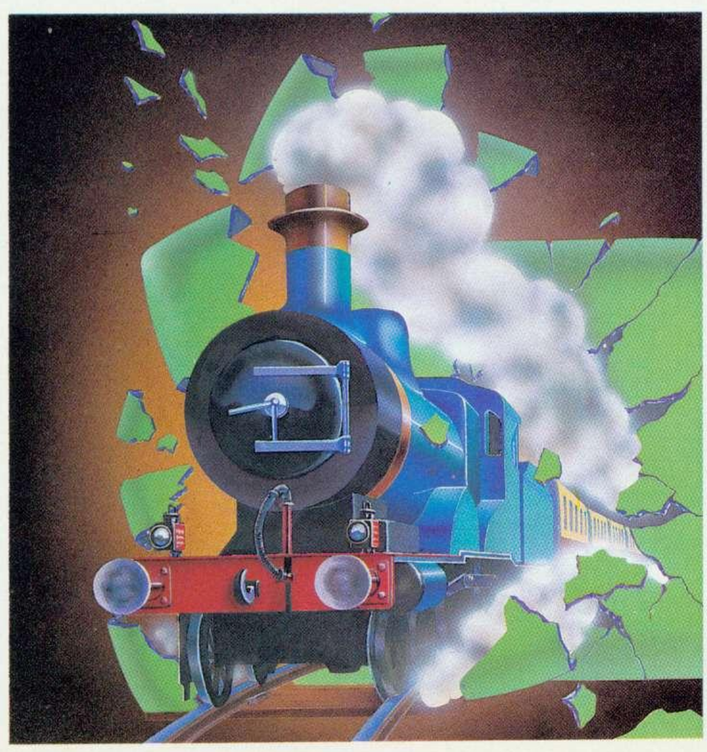
and stops the program if row or column get out of bounds. You can take out the bounds check when the program is debugged.

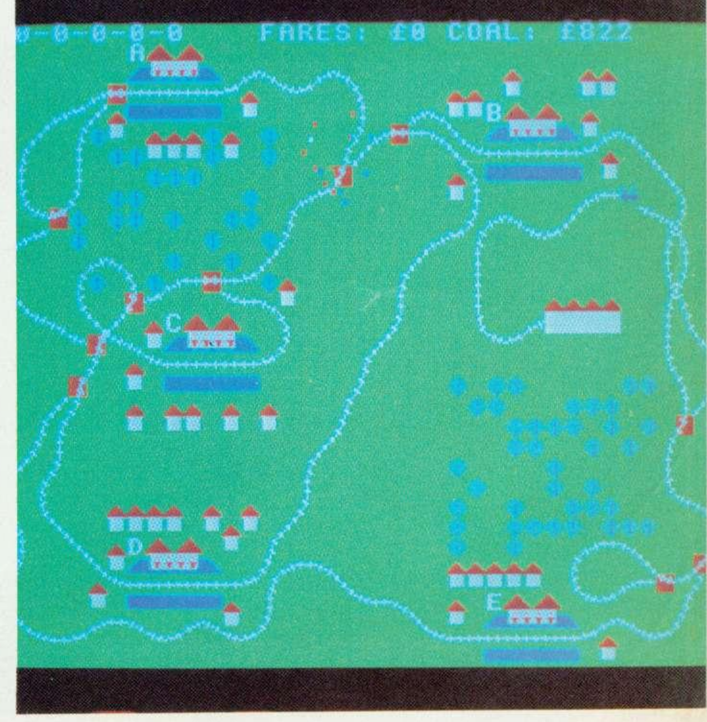
The best way to debug The Train Game (or any listing) is to type it in carefully then get someone else to read it from the magazine while you check the TV screen. If you still have a bug – or you want to modify the program – this section tells you something about the layout. All this information could have been given in REMs – but there just wasn't enough room.

You'll notice that the game loads as two programs. The first gives the rules and initialises the character set and some envelopes. Then it loads the second one – the game proper. If you don't run the first, you'll find the characters are not defined; the game will run but won't give the correct display.

The total number of characters in the cnaracter set exceeds the capacity of the user-defined character space (&C00 – &CFF). I didn't want to expand this area (using *FX20) as that doesn't work with the older operating systems. So I put the second half of the character set in the section &D00 – &DFF (but remember this is used by the disc system). The two sets are swapped as necessary. If you press break (or the program crashes) while the 'other' set is in then the track will be drawn as pieces of station and vice-versa – don't press break while the stations and towns are being drawn.

The main program starts with various





initialisations and declarations. BRD is the 'map' of the screen mentioned above. It is always accessed by

? FNBD (X,Y)

FNBD gives the address of the byte in BRD corresponding to co-ordinates (X,Y). If the program has a bug so that X or Y are not in the right range then ?FNBD (X,Y) will be outside the BRD area and you might end up writing over the Basic program (and get a BAD PROGRAM error). While debugging, replace FNBD with a function which STOPs the program if X or Y is invalid. When the program works, use the faster version of FNBD given.

A similar routine – FNNM – accesses the names of the eight best scores in a different byte area. Using strings would have been simpler but the BBC micro doesn't seem to recover the bytes from old strings properly.

The CONN array gives the input and output connections of each type of track square. Imagine each track square as a miniature Union Jack – the track connects just two of the marks (I won't call them 'points') on the periphery. For instance, a curve might connect the South mark to the North-west mark. There are 12 different track squares in all. The CONN array – and some others – are initialised by the INITPCS procedure.

The BRD map specifies which type of track square is located in each position. The track type will fit into the lower four bits (nibble) of a BRD byte. If a square holds points then the lower nibble specifies how the points are currently set and the upper nibble specifies the alternative direction. When the points are changed – by the CHGPTS procedure – the nibbles are swapped.

The TX, TY, TD, TP and TS arrays specify the location and status (Demon, stationary, direction etc) of each train. The ST array gives the locations of the five stations. The P array specifies how many passengers each train is carrying for each destination and the array holds the highest eight scores.

After the declarations and initialisations, the program enters three nested loops – for each game, for each sheet and to move the trains by one square.

The TRAINS procedure moves all the trains by one square. When a train moves to a new square, it makes a note of the type of track in the new square, puts a 'Train' byte at that position on the BRD map and draws a train pointing in the appropriate direction (the DRAW procedure). To move off, it replaces the track on the map and uses the OUT routine and the CONN array to see where the exits from the square are. It knows from which direction it entered the square and thus that the other one is the exit. The TRAINS procedure also worries about checking the keyboard, changing the points, picking up and dropping passengers and stopping and starting trains.

The TRACK procedure generates a new track layout at the start of each game, as described above. The STATIONS and TOWNS procedures of course draw the stations and towns.

The program starts a game by putting in the forests and generating a layout for the track. The track starts at the engine shed and at each end of every station in turn. (The engine shed is drawn only when the track has been laid.) The track grows from its free end until it hits something. If it hits another piece of track at a reasonable angle (and away from the engine shed) it will form points and is considered complete. If it hits anything else, it will back up by an amount depending on how much it has hit recently.

When the track is complete, the engine shed, stations, towns and passengers are drawn. No check is made that the points are put in to join the various sections of track together, so it might not be possible to get to every station. If you can't, press SHIFT while the track, stations or towns are being drawn.

A new track is drawn only at the start of the game – not for each sheet.

At the start of the game, you have four engines in the engine shed. On the first sheet you get a few minutes to practise

The Train Game is for the BBC model B with either operating system. In it, you control up to four railway trains running round a complex network of track. The track connects five stations to the engine shed and it's your job to run a passenger service between the stations.

You play the part of the signalman and can start, stop or reverse each train, and change the points on the track. When you stop at a station, you pick up and drop passengers, and the ones that get off pay a fare. When all the passengers are where they want to be, a new, more difficult, 'sheet' starts.

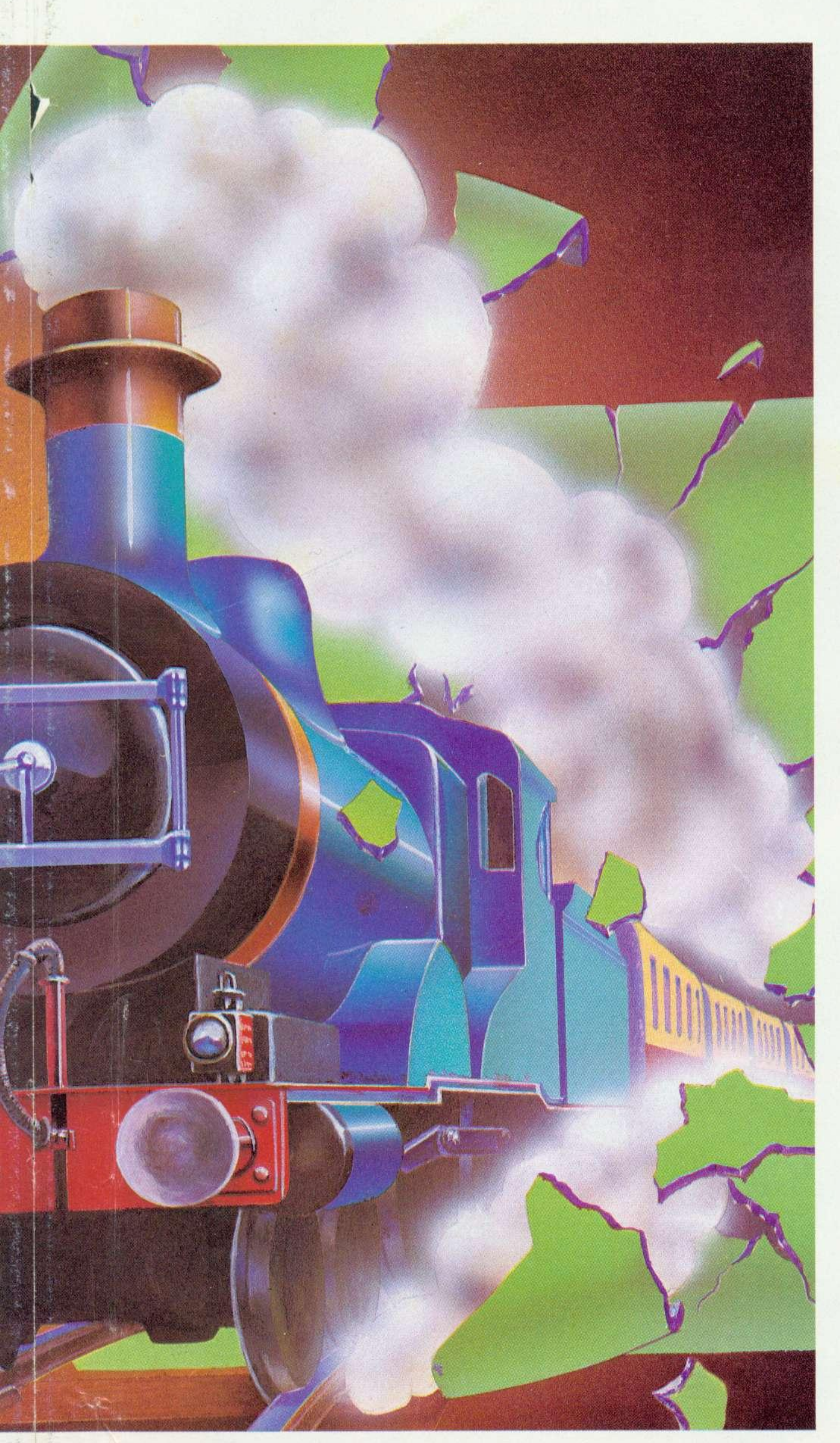
A stock of coal is provided at the start of each sheet, which the trains burn continuously – whether they are moving or not. If coal runs out before all the passengers are delivered the game is over. Each successive sheet gives you more trains, more coal and more passengers. It's more difficult with more passengers because the trains have only a limited capacity.

The trains can crash into each other, the engine shed, or points which are set against them. When that happens, you lose the train and all its passengers. The train will be replaced by another from the engine shed – either one of yours or, if there isn't one left, a 'Demon'.

Demon trains are not under your control – they run around changing points, crashing into you and generally getting in the way.

See overleaf for listings ▶





driving after the first engine has come out and before the second one emerges.

You have a maximum of two trains on the track on the first sheet. On subsequent sheets you get up to four (more than four makes the whole game run very slowly). Whenever you crash a train, another emerges from the shed – if you haven't got any more, the new one is a Demon. You're not allowed to run a rail service with fewer than two trains – the game would then be over.

You can control only one train at a time. Select the train by pressing 'Z' – this will make each train in turn 'light up' (appear on a white background). You can stop the selected train by pressing '*', but if it was already stopped it will start moving in the opposite direction. After about 20 seconds, a stationary train sounds its whistle and starts by itself.

If you press the '/' key the selected train will turn red (on a white background – a Demon is red on a green background). This means that just before the train reaches that next set of points it will change them – and turn back to blue on a white background. The points also change whenever a train leaves them – they make a sort of 'kerchunk' sound so you can tell when it's happened.

Demon trains are not under your control. They run around, changing direction whenever they hit anything and changing any points they meet.

The object of the game is to deliver passengers. At the start of each sheet there are passengers waiting at each station – you can see them standing on the platform. Every passenger wants to go somewhere else and pays his fare only when he gets there.

About *ten seconds after* you stop a train in a station all the passengers on the platform will get on and those who want to alight there will get off and pay their fare.

The top left corner of the screen shows the destinations of the passengers on the selected train. The number in the first coach shows the number of passengers to be delivered to station A, the number in the second coach shows how many for station B and so on. A coach can hold only 99 passengers so in later sheets some may be left waiting at the station – you'll have to go back for them.

When all the passengers have been delivered, you go onto the next sheet. At the start of each sheet you're given a certain amount of coal. You have to deliver all the passengers before the coal runs out. If it does, the game is over.

Your score is shown on the top line of the screen. Each passenger you deliver gives you £10. At the end of each sheet, the amount of unused coal is added and £500 subtracted for each train you crashed. You get a bonus train as your score exceeds certain values.

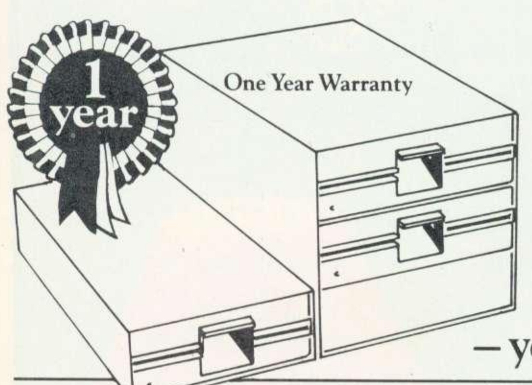
At the end of the game, the ten best scores are shown and if yours is among them you can write your name.

```
   10 REM ******************************
   20 REM *                            *
   30 REM *       THE TRAIN GAME       *
   40 REM *                            *
   50 REM *   (C) Peter Balch, 1983    *
   60 REM *                            *
   70 REM ******************************
   80
   90 GOSUB650
  100 PRINT:PRINT"Try to drive your Trai
ns -"
  110 VDU 31,26,9,148,106,32,104,60,31,2
6,10,148,111,63,111,63,135
  120 PRINT"- aroundthe track without cr
ashing.  You will    crash if you hit poi
nts that are againstyou, another train o
r the Engine Shed."
  130 PRINT:PRINT"You can control one Tr
ain at a time.     You can stop or revers
e it or change thepoints you are aproach
ing"
  140 PRINT:PRINT"The object of the game
 is to make money.Each passenger you del
iver to their     destination pays a far
e.  But they must get there before your
coal runs out.";
  150 A=INKEY(6000)
  160 REM================
  170 GOSUB 650
  180 PRINT"If there are passengers wait
ing at a     station, you will see them s
tanding on  the platform.  When you stop
 at the      station, they will get onto
your train."
  190 PRINT:PRINT"The top line shows the
 destinations of  the passengers on the
selected train."
  200 PRINT:PRINT"        #-14-0-21-4-30"
  210 PRINT:PRINT"means 14 passengers to
 station A, none   to B, 21 to C, 4 to D
and 30 to E."
  220 PRINT:PRINT"These passengers will
get off when the  train stops at their d
estination."
  230 GOSUB 1330
  240 A=INKEY(6000)
  250 REM================
  260 GOSUB 650
  270 PRINT"In later sheets, you will fi
nd there is a limit to the number of pas
sengers in  each coach - so you may have
 to make     several trips."
  280 PRINT:PRINT"When there are no more
 passengers to     deliver, you will get
a new, more        difficult, sheet and m
aybe a bonus       Train."
  290 PRINT:PRINT"Each Sheet gives you m
ore Trains - up    to a maximum of 4.  Th
e Trains come out of the Engine Shed and
 if you haven't    enough for the Sheet,
they will come outas Demons.  A Demon Tr
ain is not under  your control.";
  300 A=INKEY(6000)
  310 REM================
  320 GOSUB 650
  330 PRINT"The Game is over when you ha
ve only one Train left or have run out o
f Coal or    Money."
  340 PRINT:PRINT"Sometimes, the track m
ay have stations  you can't reach.  If t
hat happens, you  won't be able to clear
 the Sheet."
  350 PRINT:PRINT"To get a new track, ho
ld down the SHIFT key while the program
is making the      track or is putting in
 the towns."
  360 PRINT:PRINT"(There just wasn't eno
ugh room to get   the program always to
make connected    tracks.)"
  370 A=INKEY(6000)
  380 GOSUB 650
  390 REM================
  400 PRINT"Here are the different kinds
 of Trains:"''"  ";
  410 VDU 148,106,32,104,60,135:PRINT'"
 ";
  420 VDU 148,111,63,111,63,135
  430 PRINT"      One of your Trains"''"
";
  440 VDU 157,148:PRINT"_     ";:VDU 156:
PRINT'" ";
  450 VDU 157,148:PRINT"zpzw ";:VDU 156,
135:PRINT"   The Selected Train"'" ";
  460 VDU 157,148:PRINT"+'+' ";:VDU 156:
PRINT''" ";
  470 VDU 157,145:PRINT"_     ";:VDU 156,
135:PRINT"   The Selected Train will"'"
";
  480 VDU 157,145:PRINT"zpzw ";:VDU 156,
135:PRINT"   change the next points"'" "
;
  490 VDU 157,145:PRINT"+'+' ";:VDU 156,
135:PRINT"   just as it reaches them"''"
 ";
  500 VDU 145,106,32,104,60,135
  510 PRINT"       A Demon Train, not unde
r"'"  ";
  520 VDU 145,111,63,111,63,135
  530 PRINT"       your control";
  540 A=INKEY(6000)
  550 REM================
  560 GOSUB 650
  570 PRINT"Control Keys -"
  580 PRINT:PRINT"          Z  Select Train
"
  590 PRINT:PRINT"          *  Stop Train o
r start a                stationary t
rain in reverse"
  600 PRINT:PRINT"          ?  Change next
set of points            just before
hitting them"
  610 GOSUB 780
  620 PRINT:PRINT"Loading TRAINS2"
  630 CHAIN "TRAINS2"
  640 REM================
  650 MODE 7
```

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ZL 242 H	√	400K	800K	√	124	£395·00
*ZL 281 BH		400K	800K		62	£250·00
*ZL 282 BH	√	800K	1·6Mb		124	£445·00
*ZL 281 H	Expandable	400K	800K	√	62	£290·00
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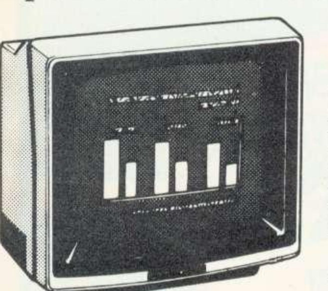
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```
 660 VDU 31,9,1,146
 670 PRINT"pppppppppppppppppp"
 680 VDU 31,9,2,146,53,31,27,2,106,31,8
,3,141,146,53,134
 690 PRINT"The TRAIN Game"
 700 VDU 31,26,3,146,106,31,8,4,141,146
,53,134
 710 PRINT"The TRAIN Game"
 720 VDU 31,26,4,146,106,31,9,5,146,53,
31,27,5,106,31,9,6,146,53,133
 730 PRINT"(c)Peter Balch"
 740 VDU 31,26,6,146,106,31,9,7,146
 750 PRINT"``````````````````":PRINT
 760 RETURN
 770 REM=================
 780 REM TRACK
 790 VDU 23,224,0,0,68,255,68,0,0,0
 800 VDU 23,225,8,28,8,8,8,28,8,8
 810 VDU 23,226,3,3,4,24,24,32,192,192
 820 VDU 23,227,192,192,32,24,24,4,3,3
 830 VDU 23,228,5,78,122,160,0,0,0,0
 840 VDU 23,229,8,48,24,16,32,192,96,12
8
 850 VDU 23,230,1,6,3,4,4,12,6,8
 860 VDU 23,231,8,6,12,4,4,3,6,1
 870 VDU 23,232,0,0,0,5,6,90,96,160
 880 VDU 23,233,128,96,192,32,16,24,48,
8
 890 VDU 23,234,0,0,0,160,96,90,6,5
 900 VDU 23,235,208,50,46,5,0,0,0,0
 910 VDU 23,236,208,50,46,5,0,0,0,0
 920 VDU 23,237,0,0,0,160,96,90,6,5
 930 REM=================
 940 REM LOCOMOTIVES
 950 VDU 23,238,8,112,230,247,253,30,30
,25
 960 VDU 23,239,28,20,28,20,62,62,62,34
 970 VDU 23,240,16,14,103,239,191,120,1
20,152
 980 VDU 23,241,64,71,70,255,255,102,0,
0
 990 VDU 23,243,2,226,98,255,255,102,0,
0
1000 VDU 23,244,25,54,30,143,95,120,120
,56
1010 VDU 23,245,34,62,62,62,20,28,20,28
1020 VDU 23,246,152,108,120,241,250,30,
30,28
1030 REM======================
1040 REM PASSENGERS
1050 VDU 23,253,0,24,0,60,24,24,24,0
1060
1070 REM HOUSE
1080 VDU 23,254,0,0,0,24,60,126,255,255
1090 VDU 23,255,126,126,126,126,126,0,0
,0
1100 PROCSWOP
1110 REM======================
1120 REM TREES,STATIONS,ETC
1130 VDU 23,225,0,7,15,31,63,127,255,0
1140 VDU 23,226,0,224,240,248,252,254,2
55,0
1150 VDU 23,227,255,255,255,255,255,255
,0,0
1160 VDU 23,228,0,255,255,255,255,255,2
55,0
1170 VDU 23,229,4,14,31,63,127,255,255,
0
1180 VDU 23,230,0,0,0,129,195,231,255,0
1190 VDU 23,231,32,112,248,252,254,255,
255,0
1200 VDU 23,232,255,255,255,255,255,255
,0,0
1210 VDU 23,233,0,8,42,28,73,42,28,8
1220 PROCSWOP
1230 RETURN
1240 REM=================
1250 DEF PROCSWOP
1260 REM  Swop the char set with the
1270 REM  user routine space.
1280 FOR I=&C00 TO &CFF
1290  J=?I: ?I=I?256: I?256=J
1300 NEXT
1310 ENDPROC
1320 REM=================
1330 REM EFFECTS
1340 *FX9,3
1350 *FX10,3
1360 ENVELOPE 1,1, 0,0,0, 1,1,0, 6,-6,-
128,-128, 105,0:REM CHUFF
1370 ENVELOPE 2,1, 96,0,0, 100,100,100,
127,-2,-1,-1, 126,0:REM POINTS
1380 ENVELOPE 3,3, 120,0,0, 20,20,20, 9
9,-5,-1,-1, 126,0: REM PASSENGERS
1390 ENVELOPE 4,4, 0,0,0, 1,1,0, 32,-1,
-1,-1, 126,0
1400 RETURN
```

Listing 1. Type this in and save it immediately as 'TRAINS'. It prints the screen instructions and sets up various game shapes using VDU commands. Listing 2 (page 98 onwards) is the second part which is chained in by listing 1. Save both listings separately.

Disc users only: type in listing 1 and save it to disc as 'TRAINS' but change line 630 as below. This automatically shifts the whole game down in memory from &1900 (default page for DFS) to &E00 when it is run. Do not run either part until both have been saved, as memory will be overwritten.

```
 630*KEY0"LOAD ""TRAINS2""|MF.I%=0TO&19
00 S.4:I%!&E00=I%!&1900:N.|M*TAPE|MPAGE=
&E00|MOLD|MRUN|M"
```

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```
   10 DIM BRD 1239,CONN(12),TX(4),TY(4),
TD(4),TP(4),TS(4),ST(5,2),P(4,5),SC(8),N
M 130
   20 GOSUB2630
   30 FORI=1TO8:SC(I)=-1000:NEXT
   40 $NM=STRING$(128,CHR$13)
   50 REPEAT
   60 *FX9,3
   70 *FX10,3
   80 FORX=0TO1239:BRD?X=0:NEXT
   90 MODE 1
  100 VDU 23;8202;0;0;0,12
  110 NS=4: M%=1: P%=0: BT=2500: MAXP=10
: BG=1
  120 VDU 19,0,2;0;19,1,1;0;19,2,4;0;19,
3,7;0;
  130 PROCSTATIONS: PROCINITPCS: PROCTRA
CK: IF INKEY-1 THEN 80
  140
  150 TC=0: TT=0: M%=M%-(M%<4): S%=1: T%
=0: MAXP=MAXP-10*(MAXP<200): C%=600+MAXP
*20: FOR N=1 TO M%: TS(N)=-1: NEXT
  160 *FX21,0
  170 BG=BG MOD 6+1: IF BG=1 OR BG=3 OR
BG=4 THEN 170
  180 VDU 19,0,BG;0;
  190 PROCTOWNS: IF INKEY-1 THEN 80
  200 REPEAT
  210  C%=C%-1
  220  VDU 31,15,0,17,3: PRINT"FARES: `"
;P%;" COAL: `";C%;"     "
  230  PROCTRAINS
  240  T%=T%-(T%<>0)
  250  REPEAT:UNTIL TIME>60: TIME=0
  260 UNTIL TT+NS<2 OR PS=0 OR C%<1
  270 REM....
  280 X=P%+C%-TC:IF X>BT THEN NS=NS+1:BT
=BT*2
  290 FOR N=1 TO M%
  300 IF TS(N)<>-1 THEN GOSUB 1230
  310 NS=NS-(TS(N)>0)
  320 NEXT
  330 IF PS=0 AND X>0 AND NS>1 THEN P%=X
: GOTO 140
  340
  350 REPEAT:UNTIL TIME>300
  360 MODE7
  370 J=0
  380 GOSUB 2630
  390 *FX21,0
  400 FOR II=7 TO 1 STEP -1
  410  I=II: IF X>SC(II) THEN I=II+1: J=
II: SC(I)=SC(J): $FNNM(I)=$FNNM(J)
  420  PRINT TAB(8,I+8);I;" ";$FNNM(I);T
AB(27,I+8);SC(I)
  430 NEXT
  440 PRINT TAB(0,18)"FARES :`";P%'"COAL
 :`";C%'"LOST  :`";TC''"PROFIT:`";X
  450 SC(J)=X
  460 IF J THEN PRINT TAB(27,J+8);X;TAB(
8,J+8);J;CHR$133;: FOR I=0 TO 14: A$=GET
$: $(FNNM(J)+I)=A$: PRINT A$;: I=I-99*(A
$=CHR$13): NEXT ELSE A=GET
  470 UNTIL FALSE
  480
  490
  500 DEF PROCTRAINS
  510 FOR N=1 TO M%
  520 IF TS(N)<>-1 THEN 540
  530 IF T%<>0 OR ?FNBD(EX,EY)=255 THEN
1040 ELSE T%=(M%=2)*99-8: TX(N)=EX: TY(N
)=EY: TP(N)=1: TD(N)=3: FOR I=1 TO 5: P(
N,I)=0: NEXT: GOSUB 1170: IF NS>0 THEN N
S=NS-1: TT=TT+1: TS(N)=0: GOSUB 2530: EL
SE TS(N)=-256
  540 X=TX(N):D=TD(N): Y=TY(N)
  550 IF ?FNBD(X,Y)<>255 THEN 1020
  560 IF TS(N)<0 THEN 820
  570
  580 J=INKEY(0): IF J=0 THEN 650
  590 IF J=90 THEN AX=S%: GOSUB 1140: PR
OCDRAW(AX)
  600 IF J<>58 THEN 620
  610 IF (TS(S%) AND 63)=0 THEN TS(S%)=T
S(S%)+30 ELSE TS(S%)=(TS(S%) AND 128) OR
 64
  620 IF J=47 THEN TS(S%)=TS(S%)+128
  630 PROCDRAW(S%)
  640
  650 IF (TS(N) AND 63)=0 OR (TS(N) AND
64) THEN 820
  660 TS(N)=TS(N)-1
  670 I=TS(N) AND 63: IF I=1 THEN SOUND
18,-12,150,8
  680 IF I<>15 OR TP(N)<>17 THEN 1030
  690 SOUND 17,3,1,12
  700 I=INT(1.6+Y/8.7): K=0
  710 X=ST(I,1): Y=ST(I,2)
  720 FOR J=1 TO 5
  730  II=FNBD(X,Y-1)-1+J: A=?II
  740  K=K+(A>0)
  750  P(N,J)=P(N,J)+A
  760  A=P(N,J)-99: IF A>0 THEN K=K+9: P
(N,J)=99: ?II=A ELSE ?II=0
  770 NEXT
  780 P%=P%+10*P(N,I): PS=PS-P(N,I): P(N
,I)=0
  790 IF K<0 THEN GOSUB 2570
  800 GOSUB 1170: GOTO 1030
  810
  820 GOSUB 1230
  830 SOUND 16,1,4,5
  840 IF TS(N) AND 64 THEN TS(N)=TS(N) A
ND 128: D=8-FNOUT(TP(N))
  850 D=FNOUT(TP(N))
  860 IF T%>0 THEN 1040
  870 IF D=-1 THEN PROCCHGPTS(X,Y,TP(N))
: GOTO 1030
  880 :
  890 X1=X: X=X+DX: Y1=Y: Y=Y+DY
  900 P1=?FNBD(X,Y): IF P1>17 AND TS(N)
AND 128 THEN PROCCHGPTS(X,Y,P1): TS(N)=T
S(N) AND 127
  910 TX(N)=X: TY(N)=Y: TD(N)=D
  920 IF FNOUT(?FNBD(X,Y))>-1 THEN 1020
  930 IF P1>15 THEN PROCCHGPTS(X,Y,P1)
```

continued on page 101

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```
 940 IF TS(N)<0 THEN 1000
 950 GOSUB 1190: TS(N)=-1: IF S%=N THEN
GOSUB 1140
 960 TC=TC+500
 970 T%=0: TT=TT-1
 980 FOR J=1 TO 5: PS=PS-P(N,J): NEXT
 990 GOTO 1040
1000 TX(N)=X1: TY(N)=Y1
1010 TD(N)=8-TD(N)
1020 I=FNBD(TX(N),TY(N)): TP(N)=?I: ?I=
255
1030 PROCDRAW(N)
1040 NEXT: ENDPROC
1050
1060
1070 DEF PROCCHGPTS(X,Y,P): IF P<255 TH
EN ?FNBD(X,Y)=P DIV 16+(P AND 15)*16: VD
U 17,3,17,129+(P=17),31,X,Y,223+P/16,17,
128: IF P>17 THEN SOUND 16,2,1,25
1080 ENDPROC
1090
1100 DEF PROCDRAW(N): VDU 17,2: IF S%=N
 THEN VDU 17,131: IF TS(N) AND 128 THEN
VDU 17,1
1110 IF TS(N)<0 THEN VDU 17,1
1120 VDU 31,TX(N),TY(N),TD(N)+238,17,12
8: ENDPROC
1130
1140 I=0: REPEAT: I=I+1: S%=S%+1: IF S%
>M% THEN S%=1
1150 UNTIL TS(S%)>=0 OR I>M%
1160 IF I>M% THEN ND=M%
1170 VDU 30,17,3,241:FOR I=1 TO 5: PRIN
T ;"-";P(S%,I);:NEXT: PRINT"      ": RETUR
N
1180
1190 SOUND 16,4,6,255: VDU 19,0,15;0;:
FORJ=1TO900:NEXT: VDU 19,0,BG;0;
1200 K=RND(1000): VDU5: FOR J=1 TO 2: A
=RND(-3): FOR I=1 TO 150 STEP 3: GCOL 3,
RND(3): MOVE X1*32+RND(I)-I/2,1024-Y1*32
+RND(I)-I/2: PRINT".": NEXT:NEXT: VDU4:
A=RND(-K)
1210 RETURN
1220
1230 ?FNBD(TX(N),TY(N))=TP(N)
1240 IF TP(N)<15 THEN VDU 17,3,31,TX(N)
,TY(N),TP(N)+223: ELSE PROCCHGPTS(TX(N),
TY(N),TP(N))
1250 RETURN
1260 DEF FNBD(X,Y)=BRD+X+Y*40-40
1270 DEF FNNM(I)=NM+I*16-16
1280
1290
1300 DEF PROCTRACK
1310 SX=EX: SY=EY: SD=3: GOSUB 1470
1320 FOR II=1 TO 5
1330  AX=ST(II,1): AY=ST(II,2)
1340  FOR XX=AX-5 TO AX-1
1350   ?FNBD(XX,AY)=0
1360  NEXT
1370  FOR XX=AX TO AX+4
1380   VDU 31,XX,AY,224
1390  NEXT
1400  SX=AX-1: SY=AY: SD=3: GOSUB 1470
1410  FOR XX=AX+5 TO AX+9
1420   ?FNBD(XX,AY)=0
1430  NEXT
1440  SX=AX+5: SY=AY: SD=5: GOSUB 1470
1450 NEXT
1460 ENDPROC
1470
1480 X=SX: Y=SY: D=SD: WRONG=0
1490 DX=0:DY=0
1500 P=RND(12)
1510 IF FNOUT(P)=-1 THEN 1500
1520 IF INKEY-1 THEN ENDPROC
1530 SOUND 17,-12,1,1
1540 ?FNBD(X,Y)=P: VDU 17,3,31,X,Y,223+
P: X=X+DX: Y=Y+DY
1550 IF X>39 OR X<1 OR Y>30 OR Y<2 THEN
 1630
1560 BXY=?FNBD(X,Y): IF BXY=0 OR ABS(EX
-X)+ABS(EY-Y)<12 THEN 1620
1570 IF BXY>10 THEN 1630
1580 I=D: P=1
1590 IF FNOUT(P)=-1 THEN 1610
1600 D=8-D: IF FNOUT(BXY)>-1 THEN ?FNBD
(X,Y)=BXY*16+P: VDU 17,129,31,X,Y,223+P,
17,128: RETURN
1610 D=I: P=P+1: IF P<13 THEN 1590
1620 IF BXY=0 THEN WRONG=WRONG+(WRONG>0
): GOTO 1500
1630 WRONG=WRONG+2
1640 I=1: D=8-D: DY=INT(D/3)-1: DX=INT(
D-3*DY)-4
1650 X=X+DX: Y=Y+DY: P=?FNBD(X,Y)
1660 SOUND 17,1,200,99
1670 IF P=0 OR P>16 THEN 1470
1680 P=FNOUT(P): VDU 31,X,Y,32: ?FNBD(X
,Y)=0
1690 I=I+1: IF I<=WRONG/2 THEN 1650
1700 D=8-D
1710 GOTO 1500
1720
1730
1740 DEF FNOUT(P)
1750 P=P AND 15: IF P>12 OR P=0 THEN =-
1
1760 C1=INT(CONN(P)/10): C2=CONN(P)-C1*
10
1770 IF C1=8-D THEN D=C2: GOTO 1800
1780 IF C2=8-D THEN D=C1: GOTO 1800
1790 =-1
1800 DY=INT(D/3)-1: DX=INT(D-3*DY)-4
1810 =D
1820
1830
1840 DEF PROCINITPCS
1850 :
1860 RESTORE 1900
1870 FOR I=1 TO 12
1880 READ CONN(I)
1890 NEXT
1900 DATA 53,17,26,8,23,16,27,18,56,7,3
8,5
1910 ENDPROC
1920
1930
1940 DEF PROCSTATIONS
1950 DATA 8,3,27,6,10,16,8,27,27,30
1960  GOSUB 2510
```

continued on page 114

MACHINE CODE GRAPHICS

If moving shapes around quickly has you stumped, then Nick Wilkinson has some answers

FOR FAST graphical displays in games, you not only need the speed of machine code, but also to put your characters directly into screen memory. Although this is termed 'bad programming' it does give the necessary speed, detail and colour in the most efficient way (and all the good games do it). The 'official' way to do it with user-defined characters provides only two colours (foreground and background) and you need to mess about with MOVE and VDU 5 commands. Directly addressing screen memory allows for any size of character with up to 16 different colours (counting the eight flashing variations) within that character. To use this method we first need to know how the screen is laid out in memory, hence figure 1 shows the top left hand of mode 2. (Mode 2 because of its advanced colour facilities.)

Figure 1 is actually offset by &3000, meaning that location 0 is really located at &3000 + 0 = &3000 and location 1297 is located at &3000 + 1297 = &3511. Looking at any location, eg 1263, the location to the right is 1271, a difference of eight, and this is true of any location (except of course the extreme right hand column). Listing 1 is a simple FOR . . . NEXT loop which puts a white block into each screen location and at certain times a delay factor is introduced, to enhance the layout shown in figure 1.

The screen memory of mode 2 starts at &3000 and runs to &7FFF (a massive 20k). In mode 2 there are 16 different colours, represented in binary from 0000 to 1111, so each colour is represented by four binary digits. Each screen location is represented by one byte and holds the necessary information for two colour codes, meaning there are two pixels in one screen location. Table 1 shows the decimal, hexadecimal and binary representations of the 16 available colours.

We now know how screen memory (mode 2) is laid out, and that you can get two colour codes in one location, giving the resolution of 160 by 256. We now need to know how the colour is organised in the bytes of screen memory.

Figure 2 shows a possible byte value and this seems to suggest the two colours represented are yellow and magenta: however, the two colours in figure 2 are in fact blue and white. Resorting to binary notation will help us understand how the colours are organised. The binary values of blue and white are 0100 and 0111 respectively, and careful examination results in figure 3a. Bit 3 of blue goes to bit 7 of the result, bit 2 to bit 5, bit 1 to bit 3 and bit 0 to bit 1. For white, bit 3 goes to bit 6 of the result, bit 2 to bit 4, bit 1 to bit 2 and bit 0 to bit 0. The diagram is easier to understand so I suggest you remember it that way! We can check this organisation with the example from listing 1, where we put a white block into each location, with the white block being represented by &3F. Figure 3b shows the calculation.

Having dealt with how the screen and colours are organised, we can design multi-coloured characters. Let's start with a simple space invader. To take maximum advantage of the resolution we will need to design two invaders, because there are two pixels in one location. When designing

0	8	16	24	→ 608	616	624	632
1	9	17	25	→ 609	617	625	633
2	10	18	26	→ 610	618	626	634
3	11	19	27	→ 611	619	627	635
4	12	20	28	612	620	628	636
5	13	21	29	→ 613	621	629	637
6	14	22		614	622	630	638
7	15	23			623	631	639
640	648	656			→ 1256	1264	1272
641	649	657			1257	1265	1273
642	650	658			1258	1266	1274
643	651	659			1259	1267	1275
644	652	660			1260	1268	1276
645	653	661			→ 1261	1269	1277
646	654	662			1262	1270	1278
647	655	663			1263	1271	1279
1280	1288	1296			1896	1904	1912
1281	1289	1297			1897	1905	1913

Figure 1. Top left corner of mode 2 screen memory

Colour	Decimal	Binary	Hex
Black	0	0000	0
Red	1	0001	1
Green	2	0010	2
Yellow	3	0011	3
Blue	4	0100	4
Magenta	5	0101	5
Cyan	6	0110	6
White	7	0111	7
Flashing black/white	8	1000	8
Flashing red/cyan	9	1001	9
Flashing green/magenta	10	1010	A
Flashing yellow/blue	11	1011	B
Flashing blue/yellow	12	1100	C
Flashing magenta/green	13	1101	D
Flashing cyan/red	14	1110	E
Flashing white/black	15	1111	F

Table 1.

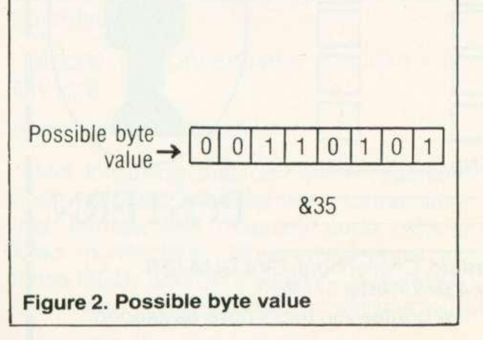


Figure 2. Possible byte value

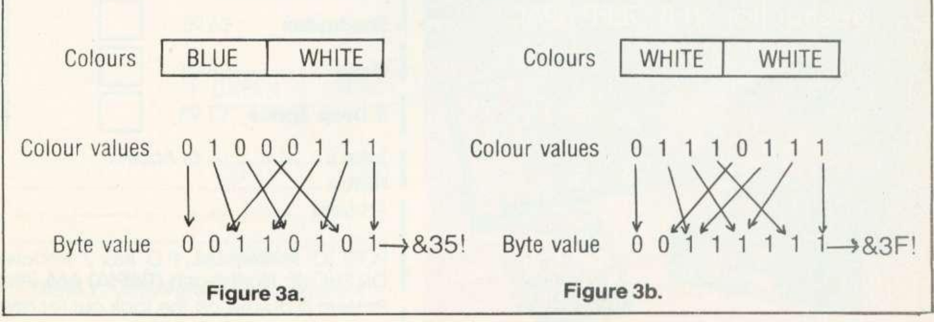


Figure 3a. **Figure 3b.**



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the characters it becomes helpful to have a border around it, so no matter what direction it moves in we won't need to worry about erasing any bits left behind.

The invaders are shown in figures 4a and b.

Once designed, the invaders have to be translated into numerical values. We could translate each block, but that would be time-consuming and boring. Another way is to create a look-up table of all the colour combinations in figure 4. Translation would then be a simple task of comparing colours. Table 2 shows all the different combinations from figure 4.

Now we have the relevant data, all we need to do is whizz through a couple of FOR . . . NEXT loops, read the data, and plonk it into memory. Listing 2 does just that (there is only one set of data as we're not bothered about moving it around yet). Line 40 starts a repeat loop and waits for an input of four hex digits (no need to use the & prefix). Line 70 calls the dump procedure with parameters declaring height, width, data line number, and memory location.

The height in this case is eight, the width five, the data line number 190 and the address is the evaluation of eight plus your input, ie hex value. Line 80 keeps the program going until you press either break or escape keys. Lines 90 to 180 read the data and put it row by row into the appropriate memory locations. The crucial line here is line 160 where it says S%=S%+1. This relies on the statement that the difference between two locations (one on top of the other) is one, which of course it is not, eg beneath &3007 is &3280 – certainly not a difference of one. The program is fine only if that boundary gap isn't crossed. For example, an input of &4000 is fine, but &4005 is not. If we could produce a formula to work out the relevant memory location from an X and Y co-ordinate, we wouldn't need to worry about the boundary gaps.

Looking back at figure 1, we see that it is laid out in blocks of eight, and the difference between each block corner is 640. From this the Y contribution is (Y DIV 8)*640 – this specifies which block of eight the Y co-ordinate is in and Y MOD 8 indicates the vertical position in that block. The X contribution is simply (X DIV 2)*8, as each location has two pixels and each horizontal co-ordinate is eight away from the next. So our formula for obtaining a specific memory location from an X and Y co-ordinate is:

&3000 + (Y DIV 8)*640 + Y MOD 8 + (X DIV 2)*8

where &3000 is the offset.

Not forgetting that our aim is machine code graphics, we shall have to translate that formula into machine code, which looks horrendous. One way around all those MODs and DIVs could be to write our own integer multiplication and division rou-

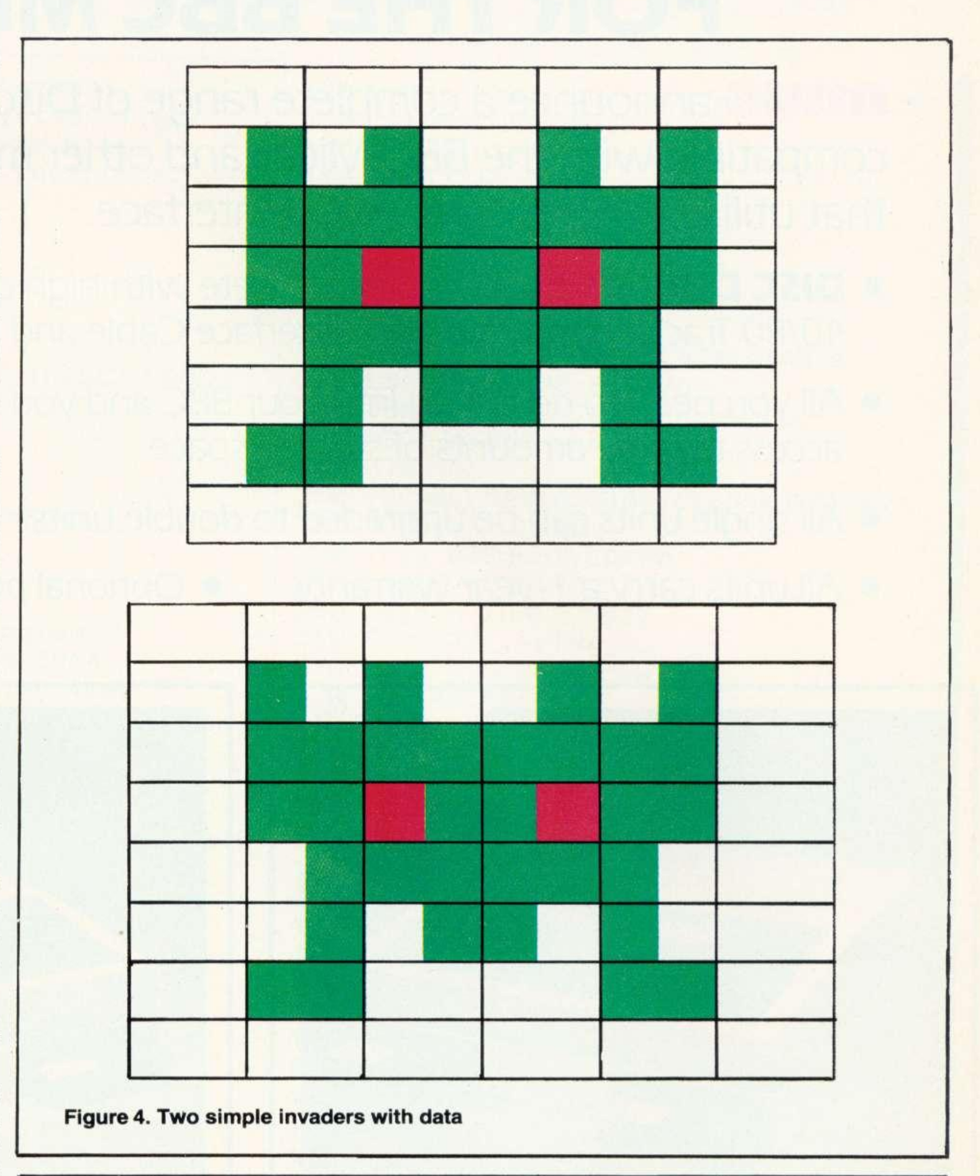


Figure 4. Two simple invaders with data

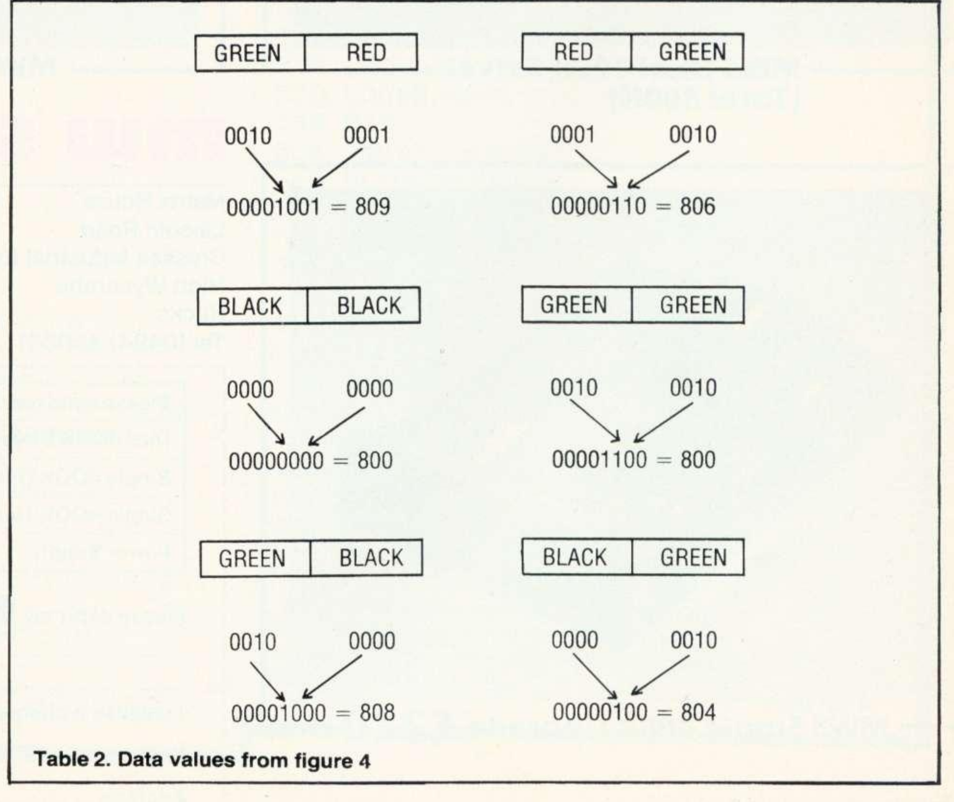


Table 2. Data values from figure 4

```
   10REM Nick Wilkinson program 1
   20REM Acorn User January 1984
   30REM Program 1 puts white block
   40REM into mode2 screen locations.
   50*TV255
   60MODE2
   70VDU23;8202;0;0;0;
   80FOR I%=0 TO 1300
   90I%?&3000=&3F
  100PRINT TAB(1,3);I%
  110IF I%<27 OR I%>620 AND I%<667 PROC
     DELAY(50)
  120NEXT I%
  130PRINT'"   ETC....":END
  140DEF PROCDELAY(X%)
  150TIME=0:REPEAT UNTIL TIME>X%
  160ENDPROC
```

Listing 1. Puts white blocks on screen

```
   10 REM Nick Wilkinson program 2
   20 REM Acorn User January 1984
   30 REM Key in hex number,eg.4000
   40 REM to plot invader
   50 MODE2
   60 REPEAT INPUT BASE$
   70 BASE%=EVAL("&"+BASE$)
   80 IF BASE%<&3000 OR BASE%>&7FFF THEN100
   90 PROCDUMP(8,5,190,BASE%)
  100 UNTIL FALSE
  110 DEFPROCDUMP(P%,Q%,R%,S%)
  120 RESTORE R%
  130 FOR I%=0 TO P%-1
  140 FOR J%=0 TO Q%-1
  150 READ Z$
  160 ?(S%+J%*8)=EVAL("&"+Z$)
  170 NEXT J%
  180 S%=S%+1
  190 NEXT I%
  200 ENDPROC
  210 DATA00,00,00,00,00
  220 DATA04,04,00,08,08
  230 DATA04,0C,0C,0C,08
  240 DATA04,09,0C,06,08
  250 DATA00,0C,0C,0C,00
  260 DATA00,08,0C,04,00
  270 DATA04,08,00,04,08
  280 DATA00,00,00,00,00
```

Listing 2.

```
   10 REM Nick Wilkinson program 4
   20 REM Acorn User January 1984
   30 REM Cursor keys display and move
   40 REM wall of multicoloured invaders
   50 PROCASSEMBLE:PROCCODEIN:MODE2
   60 VDU23;8202;0;0;0;:*FX4,1
   70 X%=0:Y%=0:REPEAT F%=0:REPEAT
   80 IF INKEY-122 THEN X%=X%+2:F%=1:IF
 X%>51 THEN X%=51
   90 IF INKEY-26 THEN X%=X%-2:F%=1:IF
X%<0 THEN X%=0
  100 IF INKEY-58 THEN Y%=Y%-2:F%=1:IF
Y%<0 THEN Y%=0
  110 IF INKEY-42 THEN Y%=Y%+2:F%=1:IF
Y%>184 THEN Y%=184
  120 UNTIL F%=1:CALLinvade:UNTIL FALSE
  130 DEFPROCASSEMBLE
  140 FORI%=0TO1:P%=&C02
  150 [OPTI%*2
  160 .invade STX&79
  170 STY&75:LDA#7:STA&7A
  180 .nexrow LDA&79:STA&74
  190 LDA#10:ADC&75:STA&75
  200 LDA#10:STA&7B
  210 .nexcol LDA#10:ADC&74:STA&74
  220 LDA&75:SBC#8:STA&75
  230 JSRdump:DEC&7B:BNEnexcol
  240 DEC&7A:BNEnexrow
  250 RTS
  260 .dump LDA#&A:STA&76:LDA#6:STA&77
  270 JSRgetX:LDX#0
  280 .rep JSRgetY:LDY#0
  290 LDA&77:STA&78
  300 .again LDA&0CA4,X
  310 STA(&72),Y:INX
  320 DEC&78:BEQnextrow
  330 TYA:ADC#8:TAY
  340 JMPagain
  350 .nextrow DEC&76:BEQret
  360 INC&75:JMPrep
  370 .ret RTS
  380 .getX LDA#0:STA&71
  390 LDA&74:AND#&FE
  400 ASLA:ROL&71
  410 ASLA:ROL&71
  420 STA&70:LDA#&30
  430 CLC:ADC&71:STA&71
  440 RTS
  450 .getY LDA#0:STA&72
  460 LDA&75:AND#&F8
  470 LSRA:LSRA:STA&73
  480 LSRA:LSRA:PHP
  490 CLC:ADC&73:ADC&71:STA&73
  500 PLP:ROR&72
  510 LDA&75:AND#&7
  520 CLC:ADC&72:ADC&70:STA&72
  530 LDA#0:ADC&73:STA&73
  540 RTS
  550 ]NEXT:ENDPROC
  560 DEFPROCCODEIN
  570 FORI%=0TO59
  580 READZ$:I%?&CA4=EVAL("&"+Z$):NEXT
  590 ENDPROC
  600 DATA00,00,00,00,00,00
  610 DATA00,00,00,00,00,00
  620 DATA00,33,33,33,33,00
  630 DATA00,23,03,03,13,00
  640 DATA00,23,0F,0F,13,00
  650 DATA00,23,4F,8F,13,00
  660 DATA00,23,03,03,13,00
  670 DATA00,33,33,33,33,00
  680 DATA00,00,00,00,00,00
  690 DATA00,00,00,00,00,00
```

Listing 4. Code can be relocated by altering P% in line 110 and call at line 90. To change location of data, alter D70 in line 440 and 0D70 in line 160

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tines, but they would be too slow for graphics. Another way would be to search through the Beeb's ROM to find the said routines, but they probably wouldn't be any faster. So it seems we'll have to translate it ourselves. Well, first note that:

(Y DIV 8) *640 = (Y DIV 8)*8*80

(figure 5 explains why this is helpful).

Figure 5 shows that (Y DIV 8)*8 is the same as setting the first three bits to zero. This is achieved by logically ANDing with &F8, so all that's left to do is multiply by 80 to achieve (Y DIV 8)*640. We could add it to itself 79 times, but that would be too slow. Alternatively, we could multiply it by 64, then by 16 as:

Y*80 = Y*(16 + 64) = Y*16 + Y*64

(You'll see why this is helpful in a minute). But before that, just a little footnote: to multiply by two in binary, just shift left one place, putting a zero in at bit 0. To divide by two, shift right one place, this time putting a zero in at bit 7.

To multiply by 64, we could shift left six times, but that would result in vital information falling off the end. An easier way would be to shift right twice – divide by four (no need to worry about bits falling off the end for we have already masked off the first three bits), then store this as the high byte of the result – which is the equivalent of multiplying by 256, hence achieving a multiplication of 64 for (Y/4)*256 = Y*64.

So far the program looks like this:

```
LDA # 0
STA YLB
STA YHB
TYA
AND # & F8
LSR A
LSR A
STA YHB
```

This section gives us (Y DIV 8)*8*64 and has to be added to (Y DIV 8)*8*16 to achieve (Y DIV 8)*640. Still in the accumulator meanwhile is (Y DIV 8)*8*64, so all we have to do is shift it right twice because

((Y DIV 8)*8*64)/4 = (Y DIV 8)*8*16.

Remembering back to the beginning we cleared the first three bits, then shifted right twice, leaving only the first bit clear. Well now we want to shift right twice again. The first shift will be OK, but the second shift will cause bit zero (possibly containing vital information) to fall off the end. However, if we use that very useful LSR operation again, bit zero will be put into the carry. A way around this is shown below.

```
LSR A
LSR A
PHP
```

So far we have stored (Y DIV 8)*8*64, and in the accumulator at the moment is (Y DIV 8)*8*16. Needless to say, we add the two together with:

Y (43)	0	0	1	0	1	0	1	1
Y DIV 8 (5)	0	0	0	0	0	1	0	1
(Y DIV 8)*8 (40)	0	0	1	0	1	0	0	0
Y (43)	0	0	1	0	1	0	1	1
&F8	1	1	1	1	1	0	0	0
Y AND#&F8 (40)	0	0	1	0	1	0	0	0

Figure 5.

Y (43)	0	0	1	0	1	0	1	1
7 AND#7 (3)	0	0	0	0	0	0	1	1
7	0	0	0	0	0	1	1	1
Y MOD 8 (3)	0	0	0	0	0	0	1	1

Figure 6.

```
CLC
ADC YHB
STA YHB
```

Now we can worry about that loss bit with:

```
PLP
ROR YLB
```

So, stored as a two-byte number in YHB and YLB, we have (Y DIV 8)*640. All that's left of the Y calculation is Y MOD 8, and from figure 6 it can be seen that Y MOD 8 is equivalent to Y AND #7. The next section does this and adds the offset of &3000 to complete our Y contribution:

```
TYA
AND#7
CLC
ADC YLB
STA YLB
LDA#&30
ADC YHB
STA YHB
```

The X contribution can be tackled in a similar manner. First (X DIV 2)*8 = (X DIV 2)*2*4. Figure 7 shows that (X DIV 2)*2 is equivalent to masking off the first bit – done by ANDing with &FE. This done, we now need to multiply it by four, which can be done by two shift lefts. There are, of course, complications, eg if X was 205 then X AND #&FE = 204, followed by two shift lefts will cause information to be lost (but with ASL, bit 7 pops into the carry). Because of this complication we will need to represent the answer over two bytes.

X (205)	1	1	0	0	1	1	0	1
X DIV2 (102)	0	1	1	0	0	1	1	0
(X DIV2)*2 (204)	1	1	0	0	1	1	0	0
&FE	1	1	1	1	1	1	1	0
X AND#&FE	1	1	0	0	1	1	0	0

Figure 7.

&70, &71	X contribution + offset of &3000
&72, &73	True address
&74	X value
&75	Y value
&76	Height
&77	Width (permanent)
&78	Width counter

Figure 8.

```
LDA #0
STA XLB
STA XHB
TXA

AND#&FE
STA XLB
ASL XLB
ROL XHB
ASL XLB
ROL XHB
```

The section above completes the X contribution, so to complete the whole calculation we only have to add the two with:

```
CLC
LDA XLB
ADC YLB
STA RLB
LDA XHB
ADC YHB
STA RHB
RTS
```

Listing 3 shows the end product. It enables you to use the cursor keys to alter the values of X and Y, and compare the accuracy and speed of Basic and machine code. The timings however mean very little as the TIME function is only in hundredths of a second. I can assure you though that the machine code version is considerably faster.

Looking back through the program again carefully, can reveal some space saving and statements that aren't needed. See if you can sort out how to save space. To give you a pointer: there is no need to store the result in a new location because it could be stored in either XLB/XHB or YLB/YHB as they aren't needed again. This has saved two bytes. Space and time saving are both important if you want maximum speed from the least amount of memory.

The routine is now complete, and it only remains to provide a screen controller program. Listing 4 is just that and has been written for maximum speed. This is why the calculation routine has been split into two sections. We only need to calculate the X contribution plus offset once, the Y contribution is then added and stored as the answer which points to a screen location. The data is loaded and stored and then the answer is incremented by eight, thus it points to the next location, ie immediately to the right. This continues until the row is finished. The Y value is then incremented and the new Y contribution is added to the X contribution plus offset and stored as the answer, etc.

In listing 4 (which takes up 12 zero-page locations – figure 8) you use the cursor keys to manipulate the position of a whole wall of multi-coloured invaders. The program uses Basic only for key detection (so as not to bog you down with code) and is written in such a way that the code is only called if you press one or more of the cursor keys, which reduces flicker to virtually zero.

The first machine code subroutine whizzes through a couple of loops dumping each invader individually. The following pseudo-Basic program will hopefully clarify the technique.

```
REPEAT
REPEAT
UNTIL KEY PRESS
FOR I = 1 TO 7
FOR J = 1 TO 10
DUMP INVADER (I, J)
NEXT J: NEXT I
UNTIL FALSE
```

where DUMP INVADER (I, J) means dump a single invader at position I, J. The only thing that isn't global about listing 4 is the address of the data. This can be rectified with the following routine (where DATED is the address of the data):

```
.CHANGEADD
LDA # (DATAD MOD 256)
STA again + 1
LDA # (DATAD DIV 256)
STA again + 2
RTS
```

This effectively changes the program by storing a different value in the program area. Although this is also considered bad technique, it is in fact the fastest and most efficient way of enabling different characters to be drawn.

Hopefully you will now be able to write your own machine code graphic simulations and games, so good luck!

```
 10 REM Nick Wilkinson program 3
 20 REM Acorn User January 1984
 30 REM Use cursor keys to move around
 40 REM screen and plot X Y numbers
 50 PROCASSEMBLE:CLS:X%=0:Y%=0
 60 VDU23;8202;0;0;0;:*FX4,1
 70 REPEAT
 80 IF INKEY-26 THEN X%=X%-1:IF X%<0 THEN X%=0
 90 IF INKEY-122 THEN X%=X%+1:IF X%>159 THEN X%=159
100 IF INKEY-58 THEN Y%=Y%+1:IF Y%>255 THEN Y%=255
110 IF INKEY-42 THEN Y%=Y%-1:IF Y%<0 THEN Y%=0
120 TIME=0:TLC%=&3000+(Y% DIV8)*640+(Y% MOD8)+(X% DIV2)*8:T1=TIME
130 TIME=0:CALLCODE:T2=TIME
140 PRINT TAB(1,3)"X = ";X%;" "''" Y = ";Y%" "
150 PRINT'" BASIC=&";~TLC%;", TIME=";T1
160 PRINT'" M/CODE=&";~!RLB AND&FFFF;", TIME=";T2
170 UNTILFALSE
180 DEF PROCASSEMBLE
190 YLB=&70:XLB=&72:RLB=&74
200 YHB=&71:XHB=&73:RHB=&75
210 DIM CODE 70
220 FOR I%=0 TO 1:P%=CODE
230 [OPT I%*2
240 LDA#0    \ CLEAR STORAGE SPACE,
250 STA YLB \ BY PUTTING ZERO INTO,
260 STA YHB \ LOCATIONS TO BE USED.
270 TYA      \ PUT Y VALUE INTO ACCUMULATOR THEN,
280 AND#&F8 \ LOGICALLY AND TO PRODUCE (Y DIV8)*8.
290 LSR A    \ DIVIDE BY 2 TWICE,ACHEIVING DIVISION BY 4,
300 LSR A    \ THEN STORE AS HIGH BYTE THUS MULTIPLY BY 256,
310 STA YHB \ NET ACHEIVEMENT IS (Y DIV8)*8*64.
320 LSR A    \ DIVIDE BY 2 TWICE THEREFORE DIVIDE BY 4,
330 LSR A    \ ACHEIVING (Y DIV8)*8*16.
340 PHP      \ SAVE CARRY FLAG.
350 CLC      \ CLEAR CARRY (IN CASE IT WAS SET).
360 ADC YHB \ ADD (Y DIV8)*8*64 TO (Y DIV8)*6*16,
370 STA YHB \ PRODUCING (Y DIV8)*8*80,THEN STORE RESULT.
380 PLP      \ RECALL SAVED CARRY AND,
390 ROR YLB \ ROTATE IT TO LOW BYTE COMPLETING (Y DIV8)*640.
400 TYA      \ PUT Y VALUE INTO ACCUMULATOR THEN,
410 AND#7    \ LOGICALLY AND TO PRODUCE Y MOD 8.
420 CLC      \ PREPARE FOR ADDITION,
430 ADC YLB \ ADD Y MOD8 TO LOW BYTE OF (Y DIV8)*640,
440 STA YLB \ AND STORE AS FINAL Y CONTRIBUTION LOW BYTE.
450 LDA#&30 \ ADD HIGH BYTE OF &3000 (&30) TO,
460 ADC YHB \ HIGH BYTE OF Y CONTRIBUTION AND,
470 STA YHB \ STORE AS FINAL Y CONTRIBUTION.
480 LDA#0    \ CLEAR,
490 STA XLB \ STORAGE,
500 STA XHB \ SPACE.
510 TXA      \ PUT X VALUE INTO ACCUMULATOR THEN,
520 AND#&FE \ LOGICALLY AND TO PRODUCE (X DIV2)*2.
530 STA XLB \ STORE (X DIV2)*2.
540 ASL XLB \ MULTIPLY (X DIV2)*2 BY 2 EQUALING (X DIV2)*4.
550 ROL XHB \ ROTATE POSSIBLE OVERFLOW INTO HIGH BYTE.
560 ASL XLB \ MULTIPLY (X DIV2)*4 BY 2 EQUALING (X DIV2)*8.
570 ROL XHB \ ROTATE POSSIBLE OVERFLOW INTO HIGH BYTE.
580 CLC      \ PREPARE TO ADD X TO Y.
590 LDA XLB \ LOAD X LOW BYTE,
600 ADC YLB \ ADD TO Y LOW BYTE,
610 STA RLB \ STORE AS RESULT LOW BYTE.
620 LDA XHB \ LOAD X HIGH BYTE,
630 ADC YHB \ ADD TO Y HIGH BYTE,
640 STA RHB \ STORE AS RESULT HIGH BYTE.
650 RTS      \ FINITO BENITO!
660 ]NEXT I%
670 ENDPROC
```

Listing 3. Machine code can be relocated by simply altering P% in line 180


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```
1970 :
1980 VDU 17,2
1990 FOR I=1 TO 50: VDU 31,24+RND(11),
16+RND(9),233,31,RND(11)+4,RND(9)+4,233:
NEXT
2000 EX=29: EY=14
2010 FOR X=EX+1 TO EX+4: FOR Y=EY-2 TO
EY+1: ?FNBD(X,Y)=255: NEXT: NEXT
2020 RESTORE 1950
2030 FOR I=1 TO 5
2040 READ X,Y: ST(I,1)=X: ST(I,2)=Y
2050 VDU 17,3,31,X,Y-2,64+I
2060 VDU 17,2,31,X,Y-1,225, 31,X+4,Y-1,
226
2070 FOR XX=X TO X+4: VDU 31,XX,Y+1,227
: NEXT
2080 FOR XX=X+1 TO X+3: VDU 31,XX,Y-1,2
28: NEXT
2090 VDU 17,1,31,X+1,Y-2,229
2100 VDU 31,X+2,Y-2,230, 31,X+3,Y-2,231
2110 FOR A=40 TO 100 STEP 25
2120  VDU 18,0,3,5,25,4,X*32+A;1056-Y*3
2;232,4
2130 NEXT
2140 FOR XX=X-5 TO X+9
2150  ?FNBD(XX,Y)=17
2160 NEXT
2170 FOR XX=X TO X+4
2180  FOR YY=Y-2 TO Y+1
2190  ?FNBD(XX,YY)=17
2200  NEXT
2210 NEXT
2220 NEXT
2230 GOSUB 2510
2240 ENDPROC
2250
2260
2270 DEF PROCTOWNS
2280 GOSUB 2530
2290 PS=0
2300 FOR II=1 TO 5
2310  X=ST(II,1): Y=ST(II,2)
2320  FOR I=1 TO 40
2330   XX=X+RND(9)-3:YY=Y+RND(7)-5
2340   IF XX<1 OR XX>39 OR YY<2 OR YY>3
0 THEN 2400
2350   J=FNBD(XX,YY)
2360   IF ?J>0 OR J?40>0 THEN 2400
2370   VDU17,1,31,XX,YY,254,17,3,31,XX,
YY+1,255
2380   ?J=255: J?40=255
2390   IF INKEY-1 THEN ENDPROC
2400  NEXT
2410  FOR XX=X TO X+4
2420   J=1-RND(MAXP)*(XX<>X+II-1)
2430   ?FNBD(XX,Y-1)=J
2440   PS=PS+J
2450  NEXT
2460  GOSUB 2570
2470 NEXT
2480 ENDPROC
2490
2500
2510  FOR I=8 TO&FF: J=I?&C00:I?&C00=I?
&900:I?&900=J:NEXT:RETURN
2520
2530 FOR I=1 TO 4: VDU 17,1,31,EX+I,EY-
1,254, 17,2, 17,131,31,EX+I,EY
2540 IF I<=NS THEN VDU 241,17,128 ELSE
VDU 32,17,128
2550 NEXT: RETURN
2560
2570 REM PASSENGERS
2580 FOR A=36 TO 100 STEP 20
2590  VDU 18,3,2,5,25,4,X*32+A;1020+36-
Y*32;253,4
2600 NEXT
2610 RETURN
2620 :
2630 MODE 7:VDU 31,9,2:GOSUB 2650
2640 VDU 31,9,3
2650 VDU 141,134
2660 PRINT"The TRAIN Game"
2670 RETURN
```

Listing 2. Type this in and save it as 'TRAINS2'. Then CHAIN in TRAINS and it will in turn CHAIN in TRAINS2. The game should then run. If you have problems seeing the top of the screen, remember *TV255,0 <BREAK> will move it down one line. If any colours need changing, see line 120 in listing 2. For example, VDU19, 3,5;0; will make the track purple!

Some tips on playing: Remember there are only three control keys:

Z – switches control between trains.
/ – changes points ahead of train under control
★ – stops train. Pressing it twice will reverse direction.

Also the train must wait 10 seconds at a station before passengers get aboard. It is obvious when this happens. The initial screen set-up takes about a minute, so be patient. *Trains* is a very different and original game. We hope you like it.

WHERE TO PUT MACHINE CODE

Ian Birnbaum looks at storage options above and below Basic and considers advanced use of the OPT command

MANY people are still unclear about how to store machine code after assembly on the BBC micro and the Electron. There are six main ways: four of them use areas above the Basic program that assembles the machine code; the other two use areas below Basic.

Putting the code above Basic

P%=TOP+1000 TOP gives the next free location above the Basic text, so by adding 1000 to it we leave space for any dynamic variables used in the program, and assemble the code above that.

LOMEM=LOMEM+250 LOMEM controls the position of the first dynamic variable. By setting it 250 above its default value (which is TOP) we reserve 250 bytes for our machine code program. It is important, however, to execute this statement before any reference to a dynamic variable.

DIM P% 250 This reserves the next 250 bytes in the free area above the Basic text and any dynamic variables used, and automatically sets P% equal to the address of the first location in this reserved block.

HIMEM=HIMEM−250 This reserves the 'top' 250 bytes below screen memory. It should be the first statement in the program and there should be no mode changes from a mode requiring less memory to a mode requiring more (eg, Mode 4 to Mode 0).

Putting the code below Basic

PAGE=PAGE+256 This instruction must be performed *before* loading the Basic program. You can then set P%=PAGE−256 within that program.

Using memory below &E00 The locations &900 to &AFF are used by the cassette system with OPENUP, OPENIN and OPENOUT commands, but not when loading and saving programs. These are also used by the RS423 port, and &9C0 to &9FF are additionally used by the speech synthesis system. Thus, &900 to &AFF may be safe areas in certain circumstances, especially when using discs.

&C00 to &CFF are reserved for user-defined graphics, so if you do not intend to use these in a particular case your machine code can be stored there.

&D01 to &DFF are safe locations only if you are not using discs and do not have sideways ROMs (eg, BCPL) fitted. With BCPL, &D90 onwards may be unreliable. &D00 itself is always unsafe with series 1 OS and above (and this includes the Electron), since 64 is always deposited there on break.

Most other locations should not generally be used for the storage of machine code programs, unless you are prepared to take great care.

As a general rule, DIM P% 250 is to be preferred, except when stand-alone machine code programs are required. In this case, using &C00 onwards is probably best (or &900 onwards if more than 256 bytes of storage are required).

Advanced use of OPT

You may want to use your BBC micro (or even your Electron) as a development machine to produce machine code programs which you want to put on EPROMs.

To do this you will need an EPROM programmer add-on. But this won't be enough. You will want your programs on EPROM to occupy memory locations above &8000, the usual ROM and EPROM locations. However, there is usually no RAM in this area, so how do you write code which uses the correct addresses?

The answer is to use OPT4 to OPT7. These are the equivalents of OPT0 to OPT3, except that you now have two assembly location variables at your disposal. P% is still the program counter, but O% is now also available: O% indicates where the assembled machine code will *physically* go in your computer. Hence you can set P% above &8000 with O% at a usual RAM location.

As an example, type in listing 1 and run it. You should obtain the display in figure 1. Note that all addresses refer to &9000 onwards, the initial value of P%, and in particular that BACK is &9002.

Nevertheless, running the one-liner in figure 2 will prove that the machine code is physically stored in START onwards, START being an address just above the Basic text, and certainly in RAM. Thus we can store the code in RAM while referring throughout the address locations in ROM—precisely what we require for our EPROM development work!

```
>FORI%=0 TO 8:PRINT~START?I%:NEXT
      A5
      70
      69
       5
      C9
      C8
      90
      FA
      60
```

Figure 2. Machine code stored in RAM

```
9000              OPT7
9000 A5 70        LDA NUM
9002              .BACK
9002 69 05        ADC #5
9004 C9 C8        CMP #200
9006 90 FA        BCC BACK
9008 60           RTS
```

Figure 1. Display from listing 1

```
10NUM=&70:DIM START 50
20P%=&9000:O%=START
30[OPT7
40LDA NUM
50.BACK
60ADC #5
70CMP #200
80BCC BACK
90RTS:]
```

Listing 1. O% indicates where the assembled machine code will physically go

Charles Bake recounts his exploits with Roman togas and five-line programs

DATA IN ROME

IN APRIL's *Acorn User* I described how two programs, *Animal* and *Explore*, were used with a class of vertically-grouped lower junior children. But apart from using the available software I also wanted to show the children how a micro could be an extremely useful tool and in particular how it could sort information rapidly. I looked at the *Factfile* program supplied as part of the MEP software package for schools but did not think it would suit my purposes. It was not a particularly powerful handler of data – 10 headings would allow for just 25 children per file and I wanted to expand my files to include the children in other classes – and, more important, it reinforced the 'black box' image of the micro. I wanted to find a way of showing what the computer was up to which would allow the children to discover that if inaccurate data were stored or if a query were not precise then the resulting answer might well not be what was wanted.

Fortunately, I had not only read an article about data handling by Frank Gregory in the *Micro Primer* reader, but had also heard him speak on the subject. Briefly, for those who do not know of his work, he describes how he used a six-line Basic program with middle school children to classify data – in this case data about an imaginary crime. In addition to this, he had also used punched cards to demonstrate how children could sort data and so check the answers given by the computer. His work was the inspiration I was looking for. His article explores the classroom possibilities of data handling in far greater depth.

This seemed an exciting idea, but I was unsure how eight and nine-year-old children would cope, so I decided to limit my experiment to the children in my class rather than start amassing data about the whole school. At the time we were engaged on a topic about the Romans and had begun to deal with the career of Julius Caesar. His ultimate assassination seemed an ideal subject on which to try out Frank Gregory's ideas.

Figure 1. Celia's fact card. Each child picked a Roman name and decided on their characteristics. Hence, Celia had brown hair, drove a chariot, had a scar and was seen at the Forum

Each child in the class picked a Roman name: Publius, Helena, Billius and the like. Then we discussed what sorts of information would have been useful to the Roman authorities following Caesar's murder in their search for the culprits (we imagined that the real villains were not Brutus and Cassius after all but as yet unidentified Romans). Various ideas were forwarded and after further discussion a final list of fields, or questions, was agreed upon:

A was the assassin a man?
B was he/she tall?
C did he/she have brown hair?
D did he/she drive a chariot?
E was he/she wearing a red toga?
F did he/she have a gold brooch?
G was he/she carrying a sword?
H did he/she bear a scar?
I or a tattoo (!)?
J and was he/she seen at the Forum on the Ides of March?

Shorthand versions of these questions were written on punched cards and each child thought what characteristics its Roman *alter ego* would possess. The children then cut away the holes on the cards which referred to those questions to which they would answer 'yes'. (Celia's card is shown in figure 1.)

Celia's card shows she is:

not a man (the hole left intact indicates 'no'),
not tall,
has brown hair (the slit cut away indicates 'yes'),
drives a chariot,
was not wearing a red toga,
was not wearing a gold brooch,
was not carrying a sword,
did have a scar,
did not bear a tattoo,
was seen at the Forum.

I then explained to the class how punched

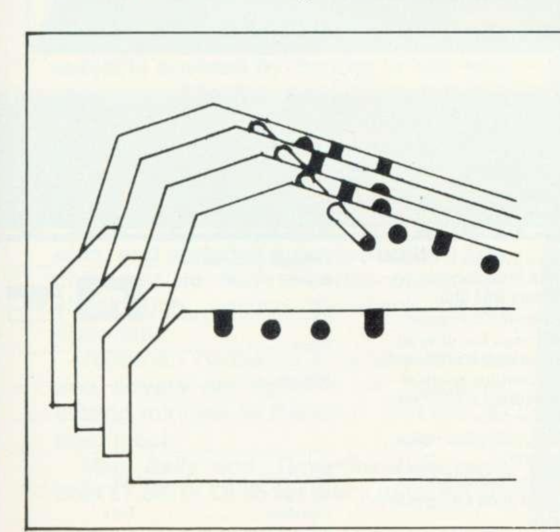
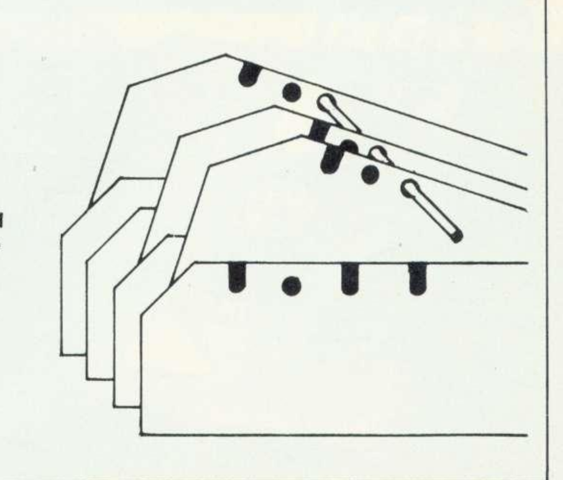


Figure 2. (a) Plastic rod is inserted to remove the 'No' cards. In this case, all the women's cards are being lifted away; (b) Rod used to remove cards of women not wearing red togas. Hence cards left behind give women wearing red togas



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```
 5 CLS
10 FOR suspect=1 TO 23
20 READ names$,A,B,C,D,E,F,G,H,I,J
30 IF A=1 AND C=0 THEN PRINT name$
40 NEXT suspect
50 DATA Celia,0,0,1,1,0,0,0,1,0,1
60 DATA Tiberius,1,0,0,0,1,1,1,0,1,1
70 DATA Marcus,1,1,1,0,0,1,1,1,0,0
```

Listing 1. Simple five-line program (followed by data for each child)

cards could be used to sift through information about the possible 'suspects' and we tried several trial sorts to see how the system worked. For example, to find out which 'Roman women' were wearing red togas it was necessary first of all to sort out those cards which referred to women. A plastic rod was inserted through the holes and slits of Question A and the 'No' cards we wanted lifted away (figure 2a).

This operation was then repeated for Question E and this time the 'Yes' cards required were left behind by the sort (figure 2b).

The next step was to introduce the children to the data handling program they would be using (listing 1). It was not easy to do this without falling in to computer jargon but I persevered and the children began to see that altering line 30 would get the micro to look for different bits of information in much the same way that inserting plastic needles through the punched cards at various places would elicit different names.

For example, if line 30 reads:

IF A=1 AND C=1 THEN PRINT name$

then the identities of those Roman men with brown hair would be revealed. Similarly, if line 30 were changed to

IF A=0 AND G=1 AND H=1 THEN PRINT names$

then the computer would look for women carrying a sword and bearing a scar.

Each child then typed in its own line of data – not easy for lower junior children when the slighest error in syntax would make the program crash. Nevertheless, they checked their own work and that of their friends and, after a couple of hours, all the lines of data had been incorporated into the program. This was then saved on tape.

I now took on the role of Roman 'Dungeon Master'. I had decided that there would be two murderers and had used the punched cards myself to discover what information I would have to reveal to the class so that just two names would be left. Over the next few days I gave clues as to the assassins' identity.

I did not do this openly but made a game of it by hiding information round the class. So the children would come across a scrawled note Sellotaped to a plastic tray or pinned to a display board informing them that 'The man had a tattoo . . . from a witness'. Other work would stop and this new information added to that already known. The punched cards would be used to see which suspects had now been eliminated and, as soon as the micro was available, the program was used to check. Sometimes we worked the other way round, using the micro first before resorting to the cards. Progress of the 'investigation' was recorded by the children in the form of Roman newspapers. These contained imagined interviews with witnesses, pleas for help and witnesses from the Roman authorities and news of the latest discoveries. Eventually the culprits, Livia and Bilius, were unmasked.

We are now engaged in a larger project involving sorting data about houses in our local area (see December's *Acorn User*). Interest has spread among the staff and I hope to involve all five lower school classes in the work.

My first experience with simple data handling had been a great success: 'When are we going to do it again?' asked the children. And 'Can you be the one that gets killed this time?' – and I thought they liked me! ●

RALLY TIME

MAPS and time are the two disparate subjects covered by Bourne in two new programs. The first uses a car rally as the excuse for learning about co-ordinates and compass bearings: the second teaches telling the time and follows on from an earlier program.

***Map Rally* is aimed at 7- to 13-year-olds, and includes a printer option. The child has to find a series of hidden checkpoints against the clock, or an opponent.**

***Timeman Two* is for 4- to 10-year-olds and covers six options for telling or setting minutes to the hour, and the 24-hour clock.**

***Map Rally* and *Timeman Two* each cost £7.80, or £9.55 for discs (plus VAT).**



Robin Ward examines the OU's awareness pack, and gives her opinions

TECHNOLOGY IN CONTEXT

Micros in Schools: an awareness pack for teachers (BBC micro edition P540, £20), Micros in Schools Project, The Open University, Walton Hall, Milton Keynes, MK7 6AA



Study Book – one of three books and four tapes in the awareness pack

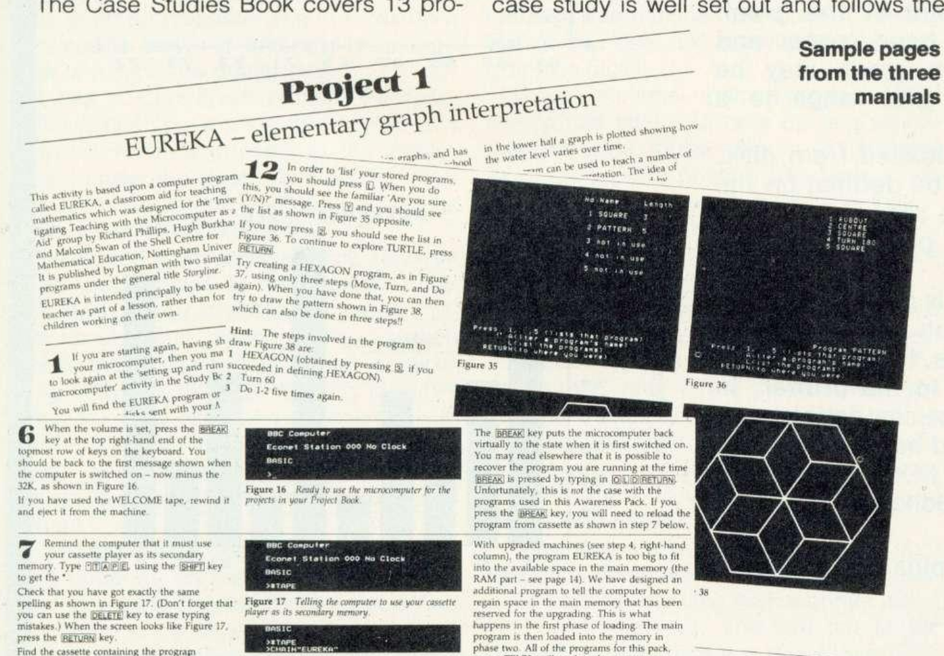
THE Open University has produced a series of awareness packs designed to help teachers to understand, with practical experience, the use of micros in schools. The project is funded by the Microelectronics Programme (MEP) and the packs are available in five editions to cover machines commonly used in schools. All booklets are easy to read, with a clear, simple style.

The BBC model B pack consists of a Study Book, a Case Studies Book, a Project Book and four cassettes of useful and interesting software.

The Study Book is designed for individual users or groups. The suggested study sequence is flexible enough to allow much individual choice and the integration of other materials into the programme is possible. Unlike the other two books, it is specific to the BBC micro.

By following the instructions for setting up and running a micro, the novice should soon become competent. Suggestions for loading and running programs and a troubleshooting guide for error messages are helpful and easily understood.

The Case Studies Book covers 13 programs on a variety of topics in the humanities, sciences, arts and mathematics. Teachers will find a comprehensive and useful coverage which should illustrate the ways they can use micros to improve the learning experiences of the pupils. Each case study is well set out and follows the same structural pattern – an introduction, how the micro was used and a critique by the teacher. The programs are well chosen and cover a number of subject areas, some not ordinarily connected with the use of micros. The 'details' which are included in each case study are important, as further information such as worksheets or instruction sheets can be obtained from the teachers who produced them.



Project 1

EUREKA – elementary graph interpretation

This activity is based upon a computer program called EUREKA, a classroom aid for teaching mathematics which was designed for the 'Inve tigating Teaching with the Microcomputer as a Aid' group by Richard Phillips, Hugh Burkha and Malcolm Swan of the Shell Centre for Mathematical Education, Nottingham Univer It is published by Longman with two simila programs under the general title *Storyline*. EUREKA is intended principally to be used teacher as part of a lesson, rather than for children working on their own.

1 If you are starting again, having sh your microcomputer, then you ma to look again at the 'setting up and run microcomputer' activity in the Study Bo You will find the EUREKA program or ... disks sent with your A

12 In order to 'list' your stored programs, you should press L. When you do this, you should see the familiar 'Are you sure (Y/N)?' message. Press Y and you should see the list as shown in Figure 35 opposite. If you now press 2, you should see the list in Figure 36. To continue to explore TURTLE, press RETURN.

Try creating a HEXAGON program, as in Figure 37, using only three steps (Move, Turn, and Do again). When you have done that, you can then try to draw the pattern shown in Figure 38, which can also be done in three steps!!

Hint: The steps involved in the program to draw Figure 38 are:
1 HEXAGON (obtained by pressing 5, if you succeeded in defining HEXAGON).
2 Turn 60
3 Do 1-2 five times again.

... graphs, and has ... school in the lower half a graph is plotted showing how the water level varies over time. ... can be used to teach a number of ... retation. The idea of ...

```
No Name    Length
1 SQUARE   3
2 PATTERN  5
3 not in use
4 not in use
5 not in use

Press 1...5 (lists that program)
  A(lter a program's name)
  L(ist the programs)
RETURN(to where you were)
```

Figure 35

```
1 SQUARE
CENTRE
SQUARE
TURN 180
SQUARE
```

Figure 36

6 When the volume is set, press the BREAK key at the top right-hand end of the topmost row of keys on the keyboard. You should be back to the first message shown when the computer is switched on – now minus the 32K, as shown in Figure 16.

If you have used the WELCOME tape, rewind it and eject it from the machine.

```
BBC Computer
Econet Station 000 No Clock
BASIC
>_
```

Figure 16 *Ready to use the microcomputer for the projects in your Project Book.*

The BREAK key puts the microcomputer back virtually to the state when it is first switched on. You may read elsewhere that it is possible to recover the program you are running at the time BREAK is pressed by typing in OLD RETURN. Unfortunately, this is *not* the case with the programs used in this Awareness Pack. If you press the BREAK key, you will need to reload the program from cassette as shown in step 7 below.

7 Remind the computer that it must use your cassette player as its secondary memory. Type *TAPE, using the SHIFT key to get the *.

Check that you have got exactly the same spelling as shown in Figure 17. (Don't forget that you can use the DELETE key to erase typing mistakes.) When the screen looks like Figure 17, press the RETURN key.

Find the cassette containing the program EUREKA, included with this pack, which is used for Project 1 in the Project Book. Insert it in your cassette player and rewind it to the start.

Type CHAIN"EUREKA".

Ensure the screen looks like Figure 18, and then press the RETURN key, followed by the PLAY button on your cassette.

You will see Figure 19, followed by Figure 20, and then the program EUREKA will begin automatically.

Stop the tape, rewind it, and put it back in its box. (The program is now loaded into the computer's main memory. You will only need the tape again if you have to repeat the loading process for some reason.)

```
BBC Computer
Econet Station 000 No Clock
BASIC
>*TAPE
```

Figure 17 *Telling the computer to use your cassette player as its secondary memory.*

```
BASIC
>*TAPE
>CHAIN"EUREKA"
```

Figure 18 *Instructing the computer to load and run EUREKA.*

```
BASIC
>*TAPE
>CHAIN"EUREKA"
Searching
Loading
EUREKA     01
```

Figure 19 *Phase one of bringing EUREKA into the computer's main memory.* (See the explanation in the right-hand column.)

```
BASIC
>*TAPE
>CHAIN"EUREKA"
Searching
Loading
EUREKA     02 02A6
First phase of CHAINing finished
Please wait for second phase to finish
>CHAIN""
Searching
Loading
EUREKA2    04
```

With upgraded machines (see step 4, right-hand column), the program EUREKA is too big to fit into the available space in the main memory (the RAM part – see page 14). We have designed an additional program to tell the computer how to regain space in the main memory that has been reserved for the upgrading. This is what happens in the first phase of loading. The main program is then loaded into the memory in phase two. All of the programs for this pack, except TELE2, will work in the same way.

Don't worry if your computer has not been upgraded – for example by fitting a disk or ECONET interface – your program will run just the same!

Should you need to repeat step 7 for any reason, you must first completely rewind the tape.

It is a good idea to get into the habit of rewinding a tape and putting it away as soon as a program has loaded. It can save a tape from accidental damage.

◁ **Figure 20** *Phase two of the loading operation.*

38

19

21

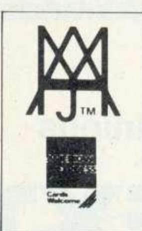
Sample pages from the three manuals

The Project Book covers precise instructions for the four programs on the cassettes. Eureka (see *Acorn User*, March p48), Turtle (a Logo program), Interest/Tele2 (illustrates how a program works), and Service (shopping simulations) are presented in a detailed and graphic fashion. There are various levels of difficulty in these programs and the most complex, Service, includes games, worksheets and ideas for additional activities.

The roles of simulations in different disciplines are described in the Project Book and should help to stimulate interest in many areas. There is also a glossary.

The examples given for most subjects are easy to understand and teachers will be quite excited by what is available to them. The pack is suitable for both primary and secondary school teachers as the material covers a wide range. Technology is very important and computers should not be seen only in information technology classes or in computer studies. Students need to be shown as wide an area as possible so they can see the relevance of technology in their everyday lives.

● **Mrs Robin Ward is assistant director of the IT Project at the Davidson Centre in Croydon, London.**

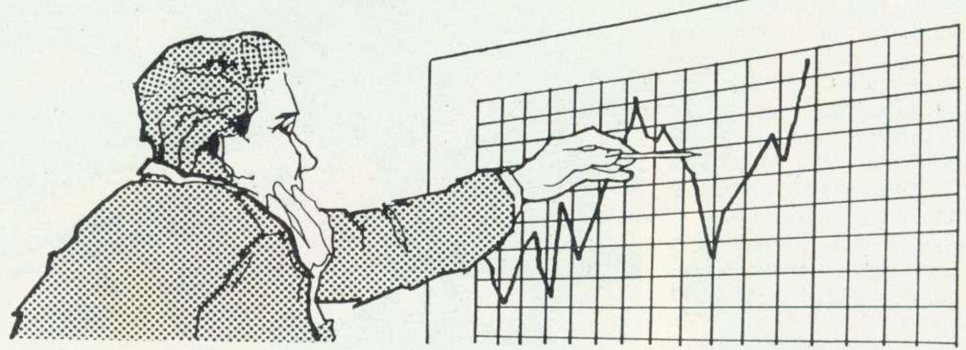


Software News

INNOVATIVE
BBC SOFTWARE
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MAXI-GRAPH

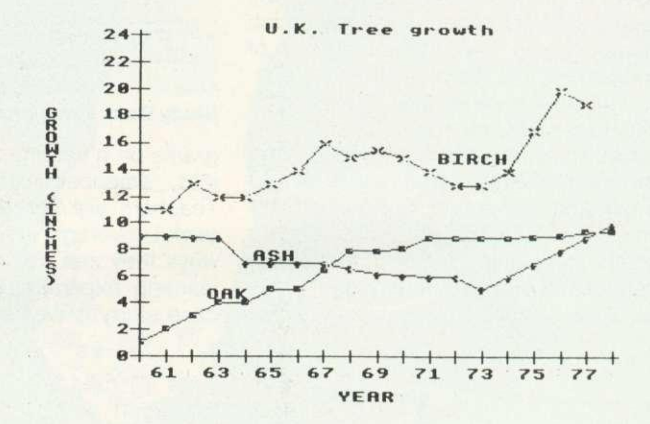


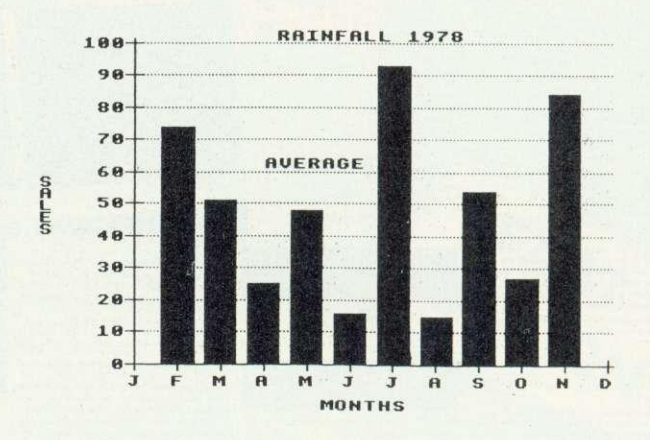
Maxi-Graph is a graph drawing program for the BBC Model B which features not only extreme ease of use, but also sophisticated graph drawing facilities. Both the curve and the background colours can be individually set and, as can be seen from the illustrations, up to three curves can be drawn on the same graph. As you can also see, bar graphs are available, in addition to curves. The latter can be linked or unlinked. Background grids may be displayed or not (they are not, in the tree growth graph). The starting point of the graph need not be in the bottom left hand corner and magnification of sections of the graph may be carried out, by restricting the plot range to a certain section of it.

Data may be saved to disk and loaded from disk. Three types of graph labels may be defined on the X axis. The first is monthly, the second is yearly and the third is a numerical general purpose definition.

Maxi-Graph is disk orientated, it is not available for tape, and gives an excellent graph representation. As can be seen by the illustrations, the graph which the user constructs can be sent to the printer, in addition to the screen. It should be compatible with most dot addressable printers and has been tested, and is guaranteed, with Epson MX80 Model III, FX80, RX80; Star 510/525; Seikosha GP100A or GP80A.

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BUDGET DAISYWHEEL

At £350, the Juki 6100 is well priced for business and home, says George Hill

THE Juki 6100 is the first reasonably priced daisywheel printer I have come across. Imported and distributed through Micro Peripherals, it sells for around £350, which brings it within the home computer user's budget and makes it a contender as a low-cost business printer.

A daisywheel printer has a printer mechanism with many moving parts, each of which has further to travel than those of a dot-matrix printer before a letter is printed (details of the process were covered in the March issue in the first of my printer articles). The result is that daisywheels tend to be bulky, noisy and slow, but these disadvantages are offset by the fact that they produce print of the highest quality, not quite matching up to a printing press but certainly as good as that of the best electric typewriter.

How does the Juki measure up to other daisywheels and to dot-matrix printers in its price range?

On first handling it you are struck by its weight – at 12.5kg it is certainly not to be put on a card table. It is also large, having a 13in carriage, which enables it to handle A4-size paper sideways if required. Thus tables of results or other data can be printed legibly, unrestricted by the limitations of an 80-character line. It takes up a lot of space, however, and requires a large desk or a separate printer station.

It has a Centronics parallel interface, which connects via a standard cable (not supplied with my printer) to the printer socket under the Beeb. An RS232C interface (compatible with the Beeb's RS423) is available as an optional extra.

The speed is an unremarkable 18 characters per second, to some extent compensated for by the rapid linefeed ('bi-directional, logic seeking, etc – which means that it prints more or less continuously with the carriage moving in either direction). It is still slow compared with even a moderate-speed dot-matrix. It takes about 3½ minutes to print a full page, though it would be quicker for program listings.

The print quality is superb. Obviously the style depends on the daisywheel in use, but I found the Courier 10 wheel supplied very much to my taste. Even the best dot-matrix printers cannot compare, and if your principal need is to impress clients with beautifully printed letters the daisywheel mechanism is unrivalled.

The Juki 6100 is friction-feed only. This means that it is at its best dealing with rolls or cut sheets of paper. I could find no reference to a roll-holder or cut-sheet feeder in the manual. Either would be an expensive extra but probably necessary to translate this into a satisfactory business machine. You have to feed the paper manually, or if you're using fanfold paper continually adjust it as it creeps across the roller.

The printer makes a lot of clattering and whirring noises while printing, and there is a continuous soft high-pitched whine which might get on your nerves in a quiet office. It is quiet by daisywheel standards though.

An impressive set of features are built in, though some of these are not very convenient to use – they seem to derive from a typewriter ancestry, when a printer had a keyboard attached.

They include proportional spacing, horizontal and vertical tab, underlining, bold printing (or bolt printing, as the manual has it), shadow (double-strike) printing, setting of left and right margins, super and subscript, variable character spacing and linefeed, an international character set selection (if you use Juki daisywheels), and a graphics facility.

The proportional spacing mode enables the narrow letters to take up less space than the wide, in the manner of handwriting. This type of printing has been available only on the more expensive daisywheels until recently. It is excellent on the Juki, though it must be cancelled if lists are to be printed, otherwise they won't align.

Emphasised modes of type are set and cancelled by simple escape sequences. The bold type isn't bold enough to be noticeable, and I had trouble with the shadow sequence, which failed to cancel on some occasions. The super and subscripts are also simple, the paper being fed half a line up or down in response to ESC U and ESC D.

The horizontal tab and the left and right margin settings are somewhat idiosyncratic, apparently deriving from a printer with a keyboard attached, and are set at the present carriage position by sending ESC 1. This is difficult to accomplish as the carriage can be moved only with the printer enabled, and then the escape sequence must be sent without being printed. The awkwardness of these settings led me to write program 4 which allows you to set the horizontal tab positions before starting work.

You can move the carriage directly to a fixed position along the line, which is more useful. This is done by sending ESC CHR$9 n (where n is the number of the position to move to).

I'm sure someone will tell me why there are complex vertical tabbing arrangements on all printers, but I have yet to discover a use for them, and there is no way to demonstrate them in a magazine article.

The graphics facility is really an extension of total carriage control. The carriage can be stepped horizontally and vertically in steps of 1/60 and 1/48 of an inch respectively, and any character can be printed at any point. I have used the facility to write a graphics dump made up of dots printed from the full stop. Other characters could be used to produce shading and other interesting effects. I shudder to think what the long-term stress on these over-used spokes of the wheel would be, and wheels are expensive to replace.

A note in the front of the manual says that this glossy booklet is only a temporary issue. It was quite clear, despite being obviously a translation from the inscrutable (for instance, item 6 is 'Setting a Paper on the Printer'). It suffers from a complete lack of programs and I hope that mine will help you.

You will notice that I still work in VDU1 terms for all escape sequences. I still find it safest. The use of VDU21 or *FX3,10 still generates results I don't expect.

The sample printout (figure 1) demonstrates the facilities available.

Program 1 is for users of Wordwise, and sets the function keys as stated in the REMs. The strip down the edge of the page (figure 2) can be inserted under the perspex cover over your normal Wordwise strip. The keys operate when SHIFT and CTRL are held down and the function key pressed.

Program 2 is a fun program which converts the Beeb/printer combination into an advanced typewriter. The function keys have actions similar to those in program 1, though the sub- and superscripts apply to individual characters rather than to strings. The main program could apply to any printer, with slight modifications according to the linefeed/carriage return arrangements.

Program 3 is the graphics dump, a simple on/off dump that has been used to print the mode 5 monochrome picture illustrated in figure 3.

My overall impression of the Juki 6100 was of a very well engineered product which requires more thought to make it user-friendly. It produces beautiful printed output, though.

This is to illustrate the normal print style

THE QUICK BROWN FOX JUMPS OVER THE LAZY DOG
The quick brown fox jumps over the lazy dog

Now in proportional spacing

THE QUICK BROWN FOX JUMPS OVER THE LAZY DOG
The quick brown fox jumps over the lazy dog

This illustrates the TAB function.

12345678901234567890123456789012345678901234567890
^POS1 ^POS20 ^

Any word or letter may be underlined or printed

in bold type or in **shadow** printing.

Good for Chemistry and mathematics.

$2NaOH + H_2SO_4 \quad Na_2SO_4 + 2H_2O$

$N_2 + 3H_2 \quad 2NH_3$

$(a + b)^2 = a^2 + 2ab + b^2$

Figure 1. Juki 6100 output demonstrating some of the machine's facilities (note there is no difference between l and 1)

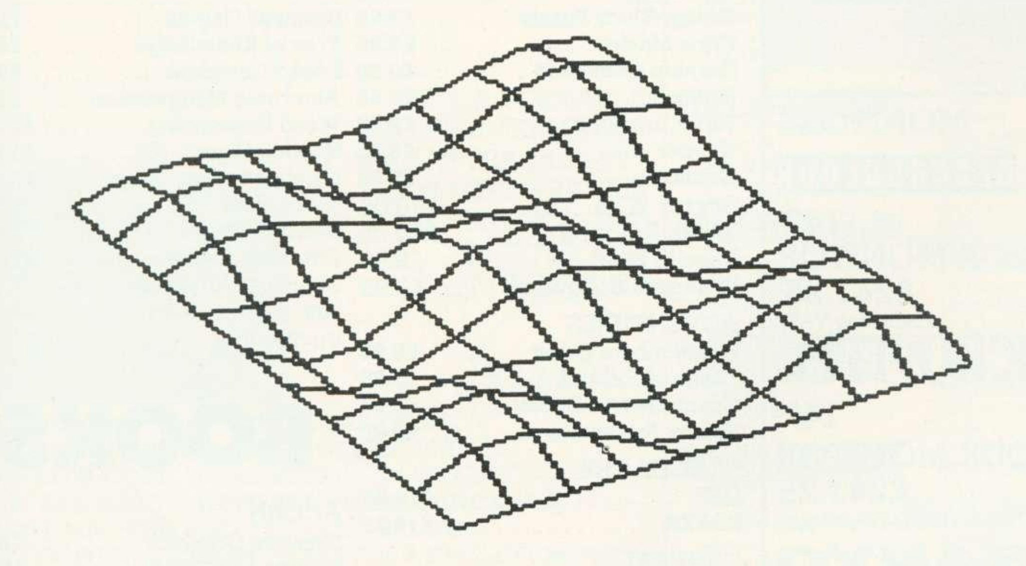


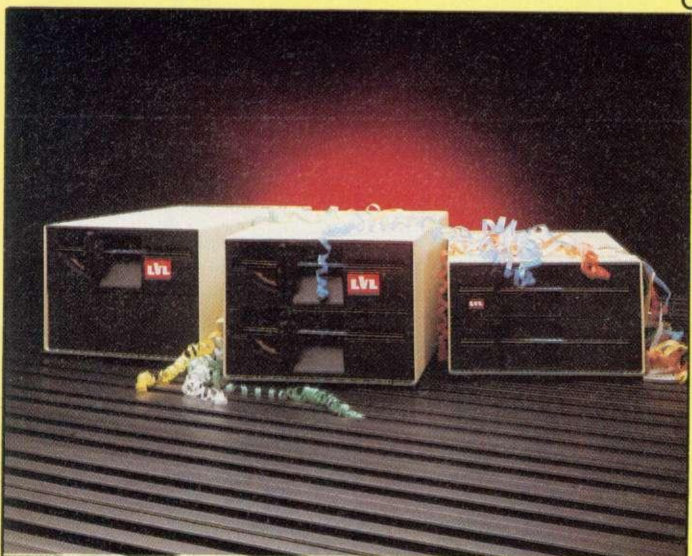
Figure 3. Simple on/off graphics dump produced by program 3

SHIFT CONTROL function keys JUKI
Up ½ line
Down ½ line
Shadow OFF
Shadow ON
Underline OFF
Underline ON
Proportional spacing OFF
Proportional spacing ON
Delete line
Paragraph

Figure 2. Function-key strip for use with Wordwise



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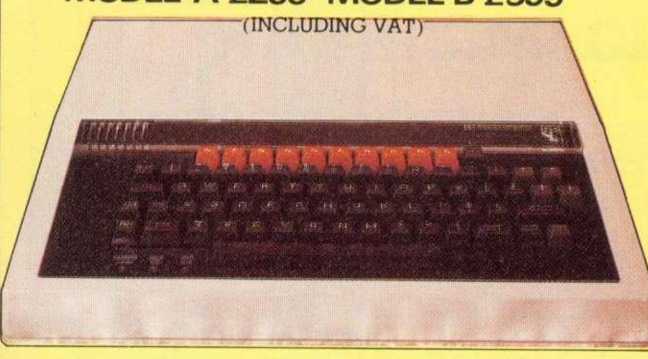
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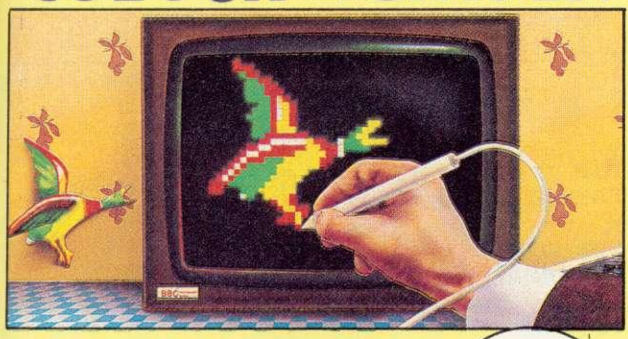


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```
   10 REM JUKI key settings
   20 REM paragraph
   30 *KEY0¦M¦!!TI6¦!"
   40 REM delete line
   50 *KEY1¦!¦L¦!#¦!¦.¦!¦L¦!#¦!
   60 REM proportional spacing ON & OFF
   70 *KEY2¦!!OC27,80¦!"
   80 *KEY3¦!!OC27,83¦!"
   90 REM underline ON and OFF
  100 *KEY4¦!!OC27,69¦!"
  110 *KEY5¦!!OC27,82¦!"
  120 REM shadow printing ON and OFF
  130 *KEY6¦!!OC27,87¦!"
  150 *KEY7¦!!OC27,38¦!"
  160 REM superscript and subscript
  170 *KEY8¦!!OC27,85¦!"
  180 *KEY9¦!!OC27,68¦!"
```

Program 1. Function keys set up for Wordwise users

```
   10 REM TYPEWRITER
   20 REM A program to make a printer be
have like a typewriter
   30 REM G.B.HILL (c) 1983
   40
   50 REM KEY settings are for the JUKI
 6100
   60
   70 REM *** main program ***
   80
   90 REM cause function keys to return
 ASCII values
  100 *FX225,128,0
  110 REM adjust display
  120 *TV255,1
  130 MODE3
  140 linelength=80:count=0
  150 REM reset printer
  160 VDU2,1,13,3
  170 REM ESCAPE key to exit
  180 ON ERROR GOTO 350
  190 CLS
  200 REM * main typing loop *
  210 REPEAT
  220 count=count+1
  230 A=GET
  240 REM function key pressed
  250 IF A>127 THEN ON (A-127) GOSUB430,
450,470,480,500,510,530,540,560,580:A=0:
count=count-1
  260 REM backspace pressed
  270 IFA=127 THEN VDU2,8,3:A=0:count=co
unt-2
  280 REM return key
  290 IF A=13 THEN VDU2,A,10,3:A=0:count
=0
  300 REM line end reached - sound bell
```

continued ▶

```
  310 IF count=linelength THEN count=0:R
EPEAT:VDU7:A=GET:UNTIL A=13:VDU2,A,10,3:
A=0
  320 VDU2,A,3
  330 UNTIL FALSE
  340
  350 MODE7
  360 *FX225,1
  370 IF ERR<>0 AND ERR<>17 THEN REPORT:
PRINT;"at line ";ERL
  380 END
  390
  400 REM *subroutines*
  410
  420 REM KEY0 paragraph
  430 VDU2,13,10,32,32,32,32,32,32,3
  440 REM KEY1 nothing
  450 RETURN
  460 REM KEYS 2&3 proportional spacing
 ON & OFF
  470 VDU2,1,27,1,80,3:RETURN
  480 VDU2,1,27,1,83,3:RETURN
  490 REM KEYS 4&5 underline ON and OFF
  500 VDU2,1,27,1,69,3:RETURN
  510 VDU2,1,27,1,82,3:RETURN
  520 REM KEYS 6&7 shadow printing ON an
d OFF
  530 VDU2,1,27,1,87,3:RETURN
  540 VDU2,1,27,1,38,3:RETURN
  550 REM KEY8 subscript
  560 A=GET:VDU2,1,27,1,85,A,1,27,1,68,3
:A=0:RETURN
  570 REM KEY9 superscript
  580 A=GET:VDU2,1,27,1,68,A,1,27,1,85,3
:A=0:RETURN
```

Program 2. Beeb/printer combination as advanced typewriter

```
1000  REM JUDUMP
1010  REM G.B.Hill (C) 1983
1020  REM dump for the JUKI 6100
1030  DEFPROCDUMP
1040  REM Enable printer
1050  VDU2
1060  REM re-initialise printer
1070  VDU1,27,1,26,1,ASC"I"
1080  REM clear paper
1090  VDU1,13,1,13,1,13
1100  FOR Y%=1023 TO 0 STEP -4
1110  REM ESC 3
1120  VDU1,27,1,51
1130  REM ESC RS 1 to set linefeed
1140  VDU1,27,1,30,1,1
1150  REM centre picture
1160  FOR I%=0 TO 89:VDU1,32:NEXT
1170  FOR X%=0 TO 1279 STEP 4
1180  IF POINT(X%,Y%)>0 THEN VDU1,46
```

continued ▶

```
 1190  VDU1,32
 1200  NEXT
 1210  REM Linefeed
 1220  VDU1,10,1,13
 1230  NEXT
 1240  REM Reset printer, disable and be
ep
 1250  VDU1,27,1,30,1,9,3,7
 1260  ENDPROC
```

Program 3. Graphics dump

```
   10 REM JUTAB
   20 REM Set horizontal tabs on JUKI 61
00 printer
   30 REM G.B.HILL (C) 1983
   40 REM *** Main Program ***
   50 DIM num(78)
   60 MODE3
   70 PROCsetup
   80 REPEAT
   90 PROCinput
  100 UNTIL num=0
  110 PRINTTAB(5,17)"Please wait"
  120 PROCsort
  130 PROCset_printer
  140 PRINTTAB(5,17)"Printer now set to
 tab at positions";
  150 FOR I=1 TO N:PRINT;" ";num(I);:NEX
T:PRINT
  160 PROCtest_tab
  170 END
  180
  190 REM *** Procedures ***
  200
  210 DEFPROCsetup
  220 PRINTTAB(0,3)"Type in positions fo
r TAB stops."
  230 PRINTTAB(0,5)"These should be numb
ers between 2 and 79"
  240 PRINTTAB(0,7)"Type RETURN when you
 have finished"
  250 N=0
  260 FOR I=1 TO 7:PRINTTAB(I*10-1,10);I
;:NEXT
  270 PRINTTAB(0,11);
  280 FOR I=1 TO 80:PRINT;I MOD 10;:NEXT

  290 ENDPROC
  300
  310 DEFPROCsort
  320 REM SORT
  330 spare=0
  340 REPEAT
```

continued ▶

```
  350 sorted=TRUE
  360 FOR I=1 TO N-1
  370 IF num(I)=num(I+1) THEN num(I+1)=8
0
  380 IF num(I)>num(I+1) THEN PROCswap
  390 NEXT
  400 UNTIL sorted
  410 N=0
  420 REPEAT
  430 N=N+1
  440 UNTIL num(N+1)=80
  450 ENDPROC
  460
  470 DEFPROCinput
  480 REPEAT
  490 N=N+1
  500 INPUTTAB(0,14)"Type in numbers now
: >"num$
  510 num=VAL(num$)
  520 OK=(num=INT(num) AND num>1 AND num
<79) OR num$=""
  530 IF NOT OK THEN VDU7:N=N-1 ELSE num
(N)=num
  540 PRINTTAB(20,14);"        "
  550 UNTIL OK
  560 IF num$="" THEN num(N)=80 ELSE PRI
NTTAB(num(N)-1,12);"^"
  570 ENDPROC
  580
  590 DEFPROCswap
  600 spare=num(I)
  610 num(I)=num(I+1)
  620 num(I+1)=spare
  630 sorted=FALSE
  640 ENDPROC
  650
  660 DEFPROCset_printer
  670 VDU2,1,27,1,50
  680 FOR I=1 TO 80
  690 FOR J=1 TO N
  700 IF num(J)=I THEN VDU1,27,1,49
  710 NEXT
  720 VDU1,32
  730 NEXT
  740 VDU3
  750 ENDPROC
  760
  770 DEFPROCtest_tab
  780 VDU2,13
  790 FOR I=1 TO 80:VDU1,(48+I MOD 10);:
NEXT
  800 PRINT
  810 FOR I=1 TO N
  820 VDU1,9,1,94
  830 NEXT
  840 VDU13,3
  850 ENDPROC
```

Program 4. Horizontal tab positions set

Barry Pickles hosts this cash-for-tips column. Here's a chance to show off your talents—and earn some crinkly green stuff into the bargain. There are reckoned to be some 40,000 of you out there and, bearing in mind that the Atom has been around for more than two years, you must have accumulated a fair amount of expertise.

What we're looking for are those little routines, tips and hardware mods you've discovered. Don't worry if your little wrinkle seems too simple—it's probably just what someone else has been looking for. The same rules apply here as in Ian Birnbaum's Beeb Forum. Short, sweet and as original as possible is the name of the game. I'll start you off, but this is your page, so let's hear from you!

Send your ideas to Atom Forum, Acorn User, 53 Bedford Square, London WC1B 3DZ. If you want it returned, enclose a SAE. It should be typed or printed, with programs on cassette (with listing if possible).

LET YOUR ATOM DO THE WALKING

SINGLE key entry of Basic seems to be in fashion these days – even the Electron has it. Personally, I think it just encourages laziness – which is why I've written the routine in listing 1. It allows you to set up the Atom so that pressing SHIFT and a letter key inserts a keyword into the input buffer at #100, where it is treated as if it were entered at the keyboard. The keywords are entered into strings A to Z. Thus, after running this routine, you may type, for example, $A="ABS" and this word will appear any time you press SHIFT-A.

Of course, you may not now enter shifted characters into your program. If you want to do this, you must BREAK and OLD, to restore normal vectors. To resume single-key entry, type !#20A=#8400 (or wherever you assemble the code to). Once assembled, the program is not needed, but don't overwrite the object code.

As written, the program occupies just under ½k in source form. The machine code begins at #8400 and the keyword strings are stored at #8600 onwards. I have restricted string length to 15 characters, but this may be altered by changing the ADC instruction in line 25. Once you have defined your strings, the whole could be saved by:

*SAVE"KEYWORDS" 8400 87FF

Remember to alter the vector, as above, after reloading.

How does it work? Briefly, location #322 to #33B and #33D to #356 hold the low and high bytes of the various string pointers. The routine first sets these to begin at #8600 ($A), and, if a shifted character is detected (lines 35 and 40), looks up the string (lines 50 and 55) and passes it down, character by character, to the buffer at #100 (lines 60-70), which then executes the code.

```
 5 REM: Single key entry
10 P=#8400; PRINT$21; [
15 LDA@0; STA#80; LDA@#86; STA#81; LDX@0
20 LDA#81; STA#33D,X; LDA#80; STA#322,X
25 CLC; ADC@16; STA#80; BCC P+4
30 INC#81; INX; CPX@27; BMI P-22
35 JSR#FE94; CMP@97; BMI P+9
40 CMP@123; BPL P+5; JSR P+4; RTS
45 SEC; SBC@97; STY#AD; TAY
50 STX#AC; LDX#AD; LDA#322,Y; STA#AE
55 LDA#33D,Y; STA#AF; LDY@0; INY
60 LDA(#AE),Y; CMP@13; BEQ P+16
65 DEY; LDA(#AE),Y; STA#100,X
70 INX; INY; JSR#FE52; JMP P-18
75 DEY; LDA(#AE),Y; CMP@1; BNE P+4
80 LDA@13; STX#AE; LDY#AE; LDX#AC; RTS
85 ]; PRINT$6
90 !#20A=#8400; END
```

Listing 1. Imitates Electron's single-key entry

LABEL SEARCH

IF YOU are writing a long program, it makes sense to use labels to speed up execution. However, it's all too easy to lose track of your labels and what the labelled routines do. Listing 2, when run, prints out in full every labelled line in the target program.

It assumes that the target program is at #2900, but you can alter this by changing the value of P in line 10. Simply, it looks through memory until it finds a (CR), followed three bytes later by an inverse character. If found, it jumps to sub.p and prints that line. Line 40 converts the line number into decimal, and lines 45 and 50 format lines so that they are printed in the same way as a LIST instruction. Line 20 checks for the end of the program (#0D followed by #FF).

```
 5 REM: Label finder
10 P=#2900; @=0; PRINT$14; DO P=P+1
15 IF?P=13; IFP?1<>255 GOSUBn
20 UNTIL?P=13 AND P?1=255
25 @=8; PRINT$15; END
30n IFP?3>96; IFP?3<123 GOSUBp
35 RETURN
40p L=P?1*256+P?2; P=P+3
45 N=10000; DO IFL<N PRINT" "
50 N=N/10; UNTILL>N
55 PRINTL,$P'; P=P+LENP-1; RETURN
```

Listing 2. Prints out labelled lines

DIFFERENT LOGIC

IN a previous Forum we briefly touched upon 'logical operators'. Page 31 of the manual seems straightforward enough, but try this:

A=3; B=4; P.(A=B),(A<>B)

Note the value of the first statement (false) and the second (true). Now, repeat the exercise but make A=−3. Oh dear! Now we get values of −255 (false) and −256 (true). This can be very disconcerting, as I found out once, when I used a logical operator as part of a calculation. If you printed the result in hex, you would see that the result was calculated using 'two's complement' arithmetic and the solution is to AND (&) the result with 1. This now returns false = 1 and true = 0, but it's at least consistent, regardless of the sign of the operators.

Interestingly, Acorn does not regard this as a 'bug' – just different.

KEEP A TAG ON LABELS

LINE labels are used to speed program execution – and very useful they are, but it helps to know how they work. When a program is first RUN, the interpreter, on encountering a line number followed by a label, stores the address of that line in a table.

Label @ is stored at 38D/38E and other labels consecutively. So, after the first encounter with the label, the interpreter simply looks up the address and performs a jump.

As you can see, if a label is used only once, there will be no saving in execution time. However, since the label vector is reset every time a labelled line is encountered, it means that if you take care with the structure of your program the same label may be used more than once. The following trivial program should help clarify this:

```
10  C=0
15a REM- FIRST USE OF LABEL
20  P."X"; C=C+1; IFC <10 G.a
25a REM- SECOND USE OF LABEL
30  P."Y"; C=C+1; IFC <20 G.a
35  RUN
```

Finally on this subject, there is an undocumented label. This is [. The reason why it's not mentioned by Acorn is that, on BREAK, the label vector area is initialised to zero, so that jumps to unlabelled lines generate a search for the label. Label [is not initialised, so take care if you use it. The vector is stored at 3C1/3C2.

AS YOU'VE ASKED . . . TWO REPLIES

FOLLOWING my look at the BBC Basic conversion board, Keith Williams of Wolverhampton has been PEEKing at various locations and found that PRINT $32775 gives a copyright message, which has him confused.

A string is a series of characters ending in a carriage return (hex D). The number 32775 is 8007 in hex format, which is a location in the Basic interpreter ROM, where you might expect to find a copyright message. A disassembler reveals that this message is followed by a carriage return, so the Atom looks at it as a string.

Odd PEEKs and POKEs like this do no lasting harm but, as you might expect, if you do something that you're not supposed to do, you get unusual results! If you find a 'real' bug, I'd certainly like to know about it, but let's not get involved in the 'Sinclair bug' syndrome that covers the letters pages of other mags.

Now to a more serious matter. Mr Howell-Pryce of Faringdon writes that, while his machine obeys COS commands normally in Atom mode, switching to BBC mode disables the *CAT, *LOAD and *SAVE options. This is not normal.

While diagnosis at a long distance is difficult, I'm 95 per cent certain that he has a faulty MOS ROM. The following program produces a unique checksum for the ROM. It takes 20 seconds to run and, if the ROM is OK, should produce the answer 7DB40. If it doesn't, the whole unit should be returned for examination and repair. The ROM address is held in A% (line 20) and the end address is contained in line 50.

It's worth while running this routine on every ROM and keeping a note of the checksum, in case the machine fails at some future date. The checksum for the Basic interpreter should be: 1B36F8

```
10  REM: CHECKSUM (BBC BASIC)
20  A% = &F000: B% = 0
30  REPEAT
40  B% = B%+(?A%): A% = A%+1
50  U. A% > &FFFF
60  P."CHECKSUM IS "~ B%
```

WAY ROUND A PAINFUL SIMULATION

HAVE you tried using the READ/DATA simulation in the manual? Painful, isn't it? Listing 3, adapted from the 'Son of Wordpack' program given in a previous Forum (July issue), provides a better solution.

Data must be entered, each item on a separate line, after the end of your program.

Two subroutines, r and n, are given, one for strings and one for numbers. As an added bonus it also saves memory since, normally, strings are stored twice – once in the program and once in the string storage area, after the program text. If you wish to store string arrays, then, after DIMensioning, allocate the value of the pointer Q to each element of the array, using a FOR . . . NEXT loop. The array will thus store only the address of each element rather than the string itself.

```
10 REM Initialise
20 Q=?18*256; DO Q=Q+1
30 UNTIL?Q=13 AND Q?3=CH"d"
40 Q=Q+4; P=Q; GOTOr
50 REM Restore
60s Q=P; RETURN
100 REM READ Demo
110r DIM T(32); DO T=Q
120 PRINT$T'; Q=Q+LEN(T)+3; UNTIL?Q=CH"*";END
150 REM DATA
160dJANUARY
170 FEBUARY
180 MARCH
190 *; REM Terminator
200 REM Replacment routine for numbers
210n DIM NN(2),T(32)
220 FORN=0 TO 2; NN(N)=Q
230 Q=Q+LEN(Q)+3; NEXT
240 FORN=0 TO 2; T=NN(N)
250 PRINT$T'; NEXT; END
```

Listing 3. Better for data

NEGLECTED MODE

MODE 0 is a neglected graphics mode on the Atom, but some interesting effects can be obtained with it. To plot in grey, just type the following, after CLEAR 0:

F.L=#8000 to #8200 S.4;
!L=#C0C0C0C0; N.

All white lines will now appear in grey. To plot black on grey, alter the above line making !L=−1.

The 6847 video chip has two colour palettes, the alternate one being selected by ?#B002=8. Try drawing something in mode 0 as grey on black, then add the following line:

DO ?#B002=8; LI.#FB8A; ?#B002=0; LI.#FB8A; U.0

You should see your drawing flashing dark and light and on a colour Atom you'll see it change colour rapidly. Plotting black on grey has an even more dramatic effect, since it is now the background which flashes.

Inverse characters will also flash, but you really need a colour board to appreciate the difference.

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The sideways RAM is such a powerful and promising device that ACORN HAS PLANNED to release a similar system on the ELECTRON.
Rather than being a software piracy aid, the Sideways RAM system is the key solution to selling more software to BBC computer users. This is because powerful sideways software can be shared by users of the same network and sold cheaper on tape, disk or by electronic mail.

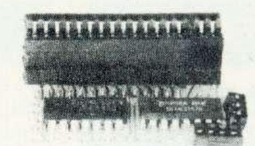
Beautifully Designed, Easily Installed, no Soldering Required:

The sideways RAM was first introduced and the first issue sold out at the ACORN USER SHOW (Sept. 83, London). The new issue has been exhibited at the PCW SHOW (Oct/Nov. 83, London) and will be on general distribution release at the BBC USER SHOW (Dec. 83, Westminster, London). The system can be installed in 2 minutes by yourself or most BBC dealers and requires no soldering.
HERE IS HOW:
Open the computer case, plug into the rightmost sideways ROM socket the cartridge base unit (see picture 1). Install your sideways ROMs, one at a time, onto the mini ROM cartridge (see figure 2), insert the cartridge into the base unit and CHAIN "ROMCOPY". This program will save your sideways ROM on disk or tape. Locate S20 and S22 jumper blocks on the computer board. Replace the jumpers with control wires from the base unit. Install the sideways RAM card in place of the mini ROM cartridge. Switch on the computer and *LOAD any program saved with "ROMCOPY". Press the BREAK key. Call up your sideways software as usual. For example, *WORD etc.
Further upgrading to 32K or to 128K is very simple: from 16K to 32K is by straight exchange (cost: £12+p&p), from 32K to 128K is by plugging in the SOLIDISK extension (see figure 3) onto the 32K sideways RAM. It costs just £76 plus p&p.

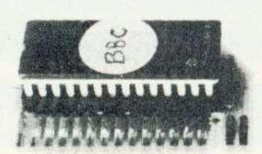
OTHER PERIPHERALS FOR THE BBC MICRO:

We are stockists of the EPSON range of PRINTERS, the SANYO range of COLOUR MONITORS, disk drives from various manufacturers and floppy diskettes (WABBASH, VERBATIM, DATALIFE, DYSAN etc.). Ring us for a quotation.

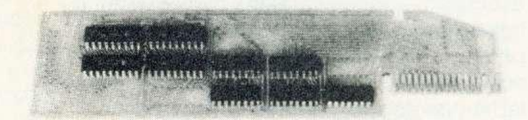
MADE IN ENGLAND
BY SOLIDISK TECHNOLOGY LIMITED
17 SWEYNE AVENUE SOUTHEND-ON-SEA
Essex SS2 6JQ
TEL: SOUTHEND (0702) 354674



THE CARTRIDGE BASE



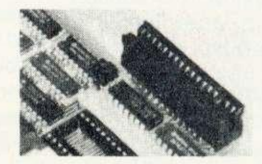
THE ROM CARTRIDGE



THE SIDE WAY RAM CARD

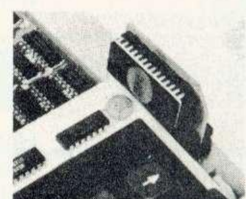


THE SILICON DISK EXTENSION

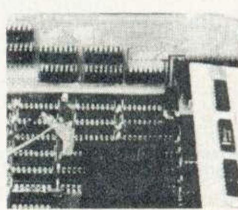




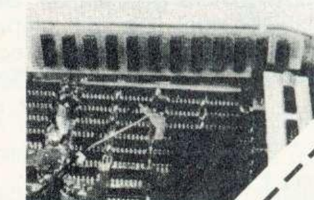
INSTALLING THE CARTRIDGE BASE



USING THE ROM CARTRIDGE TO TRANSFER SOFTWARE ON DISK



THE SIDE WAY RAM NOW REPLACES THE ROMS



THE SOLIDISK SUPER FAST DRIVE IS NOW INSTALLED

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SOLIDISK extension alone for BBC-32K Side Way Ram, if bought separately:		£76.00	
Post and packing		£1.00	£ 1.00
		TOTAL £	

Please charge my Access, Barclay account:

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ADDRESS

*Please delete/complete as applicable
*I enclose a cheque/P.O. payable to: SOLIDISK TECHNOLOGY LTD
for: £

CHRISTMAS ADVENTURE

Barry Pickles looks at the funny side of *Acorn User* and produces a special program

IT WAS a mild August evening, as we sat in the bar of the Cunard Hotel, sipping cautiously at our Electron cocktails. A tall gent, carrying Covent Garden in a glass, passed by.

'What on earth is in this thing?', exclaimed Bruce. 'Dunno', said Jeremy, 'but I think they left the ULA in mine!'

'It gets better after the fifth one,' said the floor. We looked down. It was the man from the BBC.

'Where's Tony?' asked Mad Alex, alias the guy from Acorn. 'At the printers,' we chorused. 'What – *again?*' came the retort. A tall gent, carrying Covent Garden in a glass, passed by.

'Any ideas for Christmas?' ventured Pat.

'Well,' said Joe, 'we could dress Tony in a Santa suit and send him off down Oxford Street, with a pile of *Trek* tapes.'

'I heard that,' came a voice from behind. It was Tony. 'And I don't care how hard up we are, you're not going to get me in a funny red suit and a false beard!'

'Oh, I don't know,' remarked Kitty, eyeing Tony's funny red suit, 'it looks rather fetching, especially the beard.'

'Ho, ho, ho!' replied Tony, fishing something out of his pocket. Kitty ducked.

'Mmnnff,' agreed Joe, removing the remains of a 3in disc from his mouth. 'Hmm', he mused, 'the ultimate benchtest!'

'Well, we've got to do something,' interrupted Pat.

'Look,' hissed Mad Alex, 'I don't know why you're bothering. They'll all be too busy playing with their second processors to care about your miserable jottings!' As the laughter slowly subsided, a tall gent, carrying Covent Garden in a glass, passed by, a smile flitting across his face.

'Besides,' said Tony, attempting to bring some order into the proceedings, 'what about our Atom readers?'

At the mention of the magic word, my brain began ticking over, slowly . . . very slowly. A tall gent, carrying Covent Garden in a glass, passed by . . .

And so, gentle reader, was conceived an idea, the fruits of which you are reading. (Well, I *did* say that my brain worked slowly.) It's a 'find the treasure' game, the scenario being set out in the title page. The idea is to ask the computer questions, such as 'Is it in Western Samoa?', which

```
    5REM   xmasadventure
    6REM  B.PICKLES - 1983
   10GOS.m;$T="EEE EEE EGCD"
   20P.$12'''''''''"        XMAS ADVENTURE"''
'
   30LI.M;P.$12"help!!!!"'''
   40F.N=1TO10;P.$7;N.;?#E1=0
   50P."SANTA IS IN DEEP TROUBLE!"'
   60P."HE WAS DUE TO DELIVER LOTS OF"'
   70P."ACORN'S SECOND PROCESSORS, BUT"'
   80P."HE'S LOST THE KEY TO THE STORES!
"'
   90P."CAN you HELP HIM TO FIND IT?"'''
  100P."PLEASE PRESS shift, IF YOU WOULD
"
  110P."LIKE TO TRY."''
  120DO WAIT;U.?#B001&#80=0
  130P.$12"OK, WAIT A MOMENT WHILST I PO
WER"
  140P."UP MY SENSORS"';$T="ACEGEC"
  150F=0;P=12291;GOS.d
  160?18=#30;GOS.a;GOS.c
  170P."GAME ENDED";E.
  180REM-
  185dIFP?18=97 R.
  190?T=65;T?1=13;DO
  195IF?P=#D ANDP?1=#FF F=1;G.p
  200IF?P=#D P=P+3;G.p
  210?P=?P-1;P=P+1;?T=?T+1;LI.M
  220pU.F=1;F=0;P=12291;R.
  230REM
  235cIFP?18=98 R.
  240?T=65;T?1=13;DO
  245IF?P=#D ANDP?1=#FF F=1;G.q
  250IF?P=#D P=P+3;G.q
  260?P=?P+1;P=P+1;?T=?T+1;LI.M
  270qU.F=1;P=12291;R.
  280REM-music
  290mP.$21;P=#2800;M=P;[
  300LDY@0;STY#83;LDA#28A8,Y;LDX@0
  310STX#84;CMP@#5E;BNEP+10
  320LDX#83;BNEP+6;LDX@14;STX#83
  330CMP@#2E;BNEP+10;LDX#83;BEQP+6
  340LDX@0;STX#83;CMP@13;BEQP+74
  350CMP@32;BNEP+8;LDX@27;STX#84;LDA@#41
  360CMP@#41;BMIP+57;CMP@#48;BPLP+53
  370CLC;SBC@#40;ASLA;CLC;ADC#83;TAX
  380LDA#28A9,Y;CMP@#23;BNEP+4;INX;INY
  390STY#81;LDA#2870,X;LDY#288C,X
  400TAX;LDA#B002;STX#80;LDX#80
  410DEX;NOP;NOP;NOP;BNEP-4;LDX#84
  420EOR@4;STA#B002,X;DEY;BNEP-16
  430LDY#81;INY;BNEP-105;RTS;]
  450V=#2870;!V=#ACB7BFCE;V!4=#909AA0AC
  460V!8=#78808088;V!12=#5F656B71
  470V!16=#5055555A;V!20=#4044484C;V!24=
#34383C40
  480D=256*90;GOS.t;T=#28A8;P.$6;R.
  490tF.N=0TO27;N?#288C=D/(N?#2870);N.;R.
```

Listing 1. Takes up 3½k in lower text space. Be very careful how you type it in

can only elicit a yes/no response. The computer won't actually answer yes or no, but it will tell you if you are close. When you actually find it, you will be greeted by a special message, and a seasonal tune. The key may be found anywhere in the Universe—or even outside it! But beware of black holes. The computer can respond to any input, in any language (although it replies in English), as long as it is preceeded by 'Is it' or 'Can I'.

You may repeat the game and the key will, usually, be found somewhere different from its previous location.

Because this type of game is often spoilt by reading the listing as you type it in, the crucial section has been encoded, so be *very* careful how you type it in. The program takes up 3½k and listing 1 should be entered in the lower text space, as normal. Once this is done, type: ?18=#30 (CR) and then enter listing 2 (the coded one). Break and OLD before running the whole thing. I'm not going to tell you how it works, this month, but I warn you against breaking out of the program while it is running. This may wreak havoc on your carefully typed listing! Wait until the 'Game ended' message appears.

Finally, a word about the routine that produces all those musical effects which I cannot claim credit for. It is a modified version of a routine published about two years ago in *Your Computer*. I used it because I had it and knew how to use it easily.

Next month, I'll give you a 'decoded' version of listing 2 and explain how it all comes together.

```
10SFN!!!MJTUJOH!3
20bEJNB75<Z>B/S/&6,2<F>B/S/&21,26<D>1
30Q/#PL-!XIBU(T!UIF!GJSTU!RVFTUJPO#(
40tJO/%B<M>MFOB<R>BCT)M.F*<%B>%B,6
50JGR>1!D>D,2<JGD>Z!H/f
60JGM=6!Q/#EPO(U!VOEFSTUBOE.USZ!JU!BO
PUIFS!XBZ#(<H/t
70JG!B/S/&61>24!%U>#D!B!#<H/z
80Q/#J!BN#%B(#NZ!TFOTPST!JOEJDBUF!#(
90JGR>1!Q/#ZPV!BSF!wfsz!DMPTF#(<%U>#B
$D$H$!#<MJ/N<MJ/N
100JGR?1!BOER=7!Q/#ZPV!BSF!DMPTF#(<%U>
#BDH#<MJ/N
110JGR?6!BOER=22!Q/#ZPV!BSF!TPNF!EJTUB
ODF!BXBZ#(<%U>#D!B#<MJ/N
120JGR?21!Q/#OPUIJOH#(<MJ/N
130Q/#XIBU!OPX@#(<H/t
140fQ/%23((#ZFT""""""#((<G/O>2UP4
150%U>#B$D$G#<U>U,MFOU<@U>:5<%)U,2*>#B
$/GD$#<U>$39B9
160MJ/N<O/<%U>#B$#<MJ/N
170Q/#zpv#%239#ibwf#%239#gpvoe#%239#ju
#((
180Q/#XFMM!EPOF"#(#TBOUB!DBO!CSFBUIF!B
HBJO"#(((
190G/O>2UP211<XBJU<O/<Q/#IPME!PO////#(
200Q/#J!IBWF!B!NFTTBHF!DPNJOH!JO////#(
210@U>:5<%)U,2*>#HHH!H!H!HH!H!HH!H#<U>
$39B9<G/O>2UP5<MJ/N<O/
220SFN!!nfttbhf
230Q/%23#UP!BMM!PVS!bupn!SFBEFST/////#
((
240Q/#!!!XF!IPQF!UIBU!ZPV!IBWF!B!USVMZ
#
250Q/#IBQQZ!DISJTUNBT-!BOE!XF!XJTI!ZPV
#
260Q/#QFBDF!BOE!DPOUFOUNFOU!UISPVHIPVU
#
270Q/#UIF!DPNJOH!ZFBS/#(
280Q/#UIBOL!ZPV!GPS!SFBEJOH!bdpso#%239
#vtfs#(
290Q/#!!!!!!!!!!!!............#((
300Q/#UPOZ!RVJOO!!!!!!!!!!!!!LJUUZ!NJMOF
#
310Q/#!!!!!!!!!!CBSSZ!QJDLMFT#(
320Q/#!!!BOE!BMM!BU!!BEEJTPO.XFTMFZ#(
330%U>#DG!GHGFE!B$!!EH!H#<U>U,MFOU<@U>
:5
340%)U,2*>#B/HGF!D!D!#<U>U,MFOU<@U>:5
350%)U,2*>#B!BD!B/HG!E!!DDE!H!F!G#<U>$
39B9
360sMJ/N<MJ/N<Q/#QMFBTF!XBJU//#(<@29>$
3:<S/
370zQ/%23#PI!EFBS"#(#EVF!UP!B!GSFBL!TQ
BDFXBSQ-!J(WF#(
380Q/#MBOEFE!PO!UIF!QMBOFU!PG!USBMM#(
390Q/#.BOE!XF!BMM!LOPX!XIBU(T!UIFSF-!!
EPO(U!XF@/////#(
400Q/#uif#%239#sbwfopvt#%239#cvhcmbuuf
s#%239#cfbtu#%23:(<H/s
```

Listing 2. The coded listing

THE DAN DIAMOND TRILOGY

My name is Diamond, Dan Diamond,

and this is my story. A story of beautiful mermaids, bored robots and dank, dark dungeons. A story that started one muggy day in New York, and like the Big Apple, it's rotten to the core.

The Dan Diamond Trilogy is three separate adventure games. Each game may be played on its own, but clues may be found in the earlier adventures which may help later on. Each game comes with a lavishly illustrated 20-page case file, and hints (both helpful and misleading) which have been hidden in the illustrations.

Part I. Franklin's Tomb, in which our hero receives a mysterious plea for help which leads him to a hidden tomb and the mystery of the stargate.

Part II. Lost in Space, in which our hero finds himself stranded on a derelict spacecraft, doomed to travel endlessly through space, or find a way out.

Part III. Fishy Business, in which our hero lands on a watery planet, discovers the source of the plea for help and saves the day.

"It must be the most consistently enjoyable adventure game I've ever played"
– Computer Choice (Program of the Month) –

All three programs cost £9.95 each and are available for the DRAGON 32, BBC MODEL B and 48k ORIC-1 microcomputers. (note: Fishy Business for the BBC and ORIC will be available February 1984).

Cheques or postal orders payable to:

Salamander SOFTWARE

17 Norfolk Road, Brighton, East Sussex, BN1 3AA.

Look out for Dan Diamond's next Adventure Series "Franklin in Wonderland" Available Spring 1984

FIVE PACK WITH FLAWS

Utilities Pack, Salamander, model B, £9.95

SOUND and envelope editor, Epson screen dump, teletext screen editor and analyser, and a disassembler come courtesy of Salamander in one box.

All these programs are in a form where copying to disc is possible, but the sound and Epson programs are too large to run in the available memory. The latter can be corrected by changing page to &1100, but the former needs page to be at &0E00, and so needs shifting, or loading from cassette with page set to &0E00. Neither of these facts is mentioned in the manual.

The sound program is pretty standard. I copied a similar one from *Personal Computer World* about a year ago – though I then spent the best part of a week debugging it and correcting the algorithms! You can change all the various parameters for sound in one section, and for envelope in another, and a graphical display is provided to show the current pitch and amplitude envelopes, and the current values of the parameters. The instructions are rudimentary, and the user is referred to the *User Guide* for help – not that the beginner will get much from that source!

The Epson screen dump is very versatile, dumping any part of the screen in any mode. The section of the screen to be dumped is selected by pressing T,B,L,R,H,W to alter the top, bottom etc sections of a flashing box on the screen. This is an excellent feature, but the keys sometimes do more than you expect. Unfortunately, the quality of the resulting dump is pathetic in anything but mode 0. The patterns selected are simple stripes, and produce a distorted and ugly output. The program is actually a hybrid, using the Basic section to set various parameters, so you *must* have a text window of at lest three lines for operation to be possible, and page must be reset to &1100 if the dump is to operate from disc in modes 0, 1 or 2.

The best program is the teletext screen analyser and editor. This allows you to examine the mode 7 screen, detecting all the control characters, and the ASCII codes of all printed characters (including graphics) by moving a cursor around the screen. The characters are displayed at the bottom left of the screen, and the current *x* and *y* coordinates, and the ASCII code at the bottom right. You can edit, draw and save pictures, and recall them from memory. Drawing your own pictures seems restricted to the normal ASCII alphabetic character set, and to the non-systematic graphics characters with codes less than 128. These are rather tricky to use! (A detailed diagram of the graphics set is included in the *User Guide*.) Peculiar things happened to the cursor at the corners of the screen. This program transferred directly to disc without trouble.

The disassembler is in machine code, designed to sit at the top of memory in any one of modes 0 to 2, 6 and 7 (but not modes 3, 4 or 5). It suffers from the usual problems with any disassembler, ie, lack of friendliness, and an inability to make a sensible decision as to where to start disassembling. If you start in a data table for instance, you are most unlikely to get sensible disassembly of the subsequent program.

To summarise. A good package of useful programs, all of which are, unfortunately, slightly flawed.

George Hill

KONG VARIANT

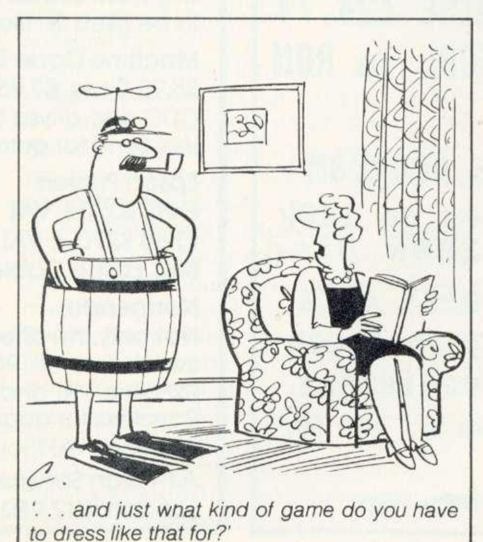
Escape from Orion, Hopesoft, BBC B, £8.95

THIS (almost) non-violent game is a variation in the *Donkey Kong* genre, ie, a little man climbs ladders, jumps gaps and moving hazards to collect objects (by jumping), all against the clock (a decreasing bonus).

In this game you've made an emergency landing to pick up tools, water, fuel rods and oxygen. When you've collected a screenful, you pop back to your flying saucer only to fly into another screen. But you never actually escape from Orion – when you've cleared the four screens (fast missiles, lifts, conveyor belts and electrified doors) you start again at the next difficulty level (maximum of nine). You can start the game from any of the four screens.

This is a fun little game that can also be used with a joystick. It has pleasant graphics, albeit spindly, and reasonable sound effects. Jumping gaps is sometimes difficult, as is often the case with this type of game. But persevere. Verdict: fairly bland – save up for *Killer Gorilla*.

Alan Pipes



'. . . and just what kind of game do you have to dress like that for?'

THREE PRACTICAL GOODIES FOR THE ATOM

- **Atom ROAM board, Timedata, £35**
- **6502 Assembly Language Programming by Lance A Leventhal, Osborne/McGraw-Hill, £11.95**
- **Practical Programs for the BBC Computer and Acorn Atom by David Johnson-Davies, Sigma Technical Press, £5.95**

GREAT stocking-fillers they may be, but where do you fit yet another Atom utility ROM? An ingenious solution is Timedata's ROAM board, a combination of ROM selector board and 4k RAM expansion. The concept is simple: put your three favourite ROMs into the sockets provided for easy access, and keep the less common ones on tape or disc, to be loaded into RAM when needed. The RAM, at #A000, can also be used for more general data storage.

You could even modify the features of ROM-based software by moving it into the RAM first, or develop your own super toolkit, with the best features of all the others.

If learning machine-code is high on your list of New Year resolutions, an excellent book to consider is *6502 Assembly Language Programming* by Lance Levanthal. Each 6502 instruction is briefly but adequately covered, but the author really scores by providing a host of useful routines (seven chapters' worth!) for common programming tasks, with exercises to test and stretch your understanding. Interface chips, interrupts, design, debugging and documentation all receive the same thorough treatment.

The book is not machine-specific, but don't let that worry you. It's a fine reference work, which you'll consult time and time again. A wealth of information for your money.

For those who'd like machine-code efficiency without tears, take a look at *Practical Programs for the BBC Computer and Acorn Atom* by David Johnson-Davies. The final chapter (worth the price of the book alone) details a complete, if modest, compiler for SPL, a Simple Programming Language. This takes high-level statements and converts them painlessly into fast, compact machine-code. For the more ambitious, the author also suggests ways of expanding the compiler.

Other chapters cover games, graphs, and words and numbers, presenting serious concepts in an entertaining and easily digested form. In all, a welcome blend of theory and fun.

Vincent Fojut

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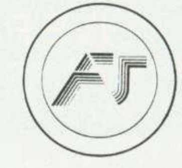
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BBC Micro Toolbox by Ian Trackman, BBC Publications, BBC model B (series 1 OS), £21

TOOLBOX is an extremely useful collection of 25 utility routines. They are all written by Ian Trackman, whom many of you know from the BBC series *Making the Most of the Micro;* and indeed, it seems that most of the routines were written to help him produce programs for the series.

The routines fall into two groups: the first consists of 13 routines which are designed to be incorporated into your own programs.

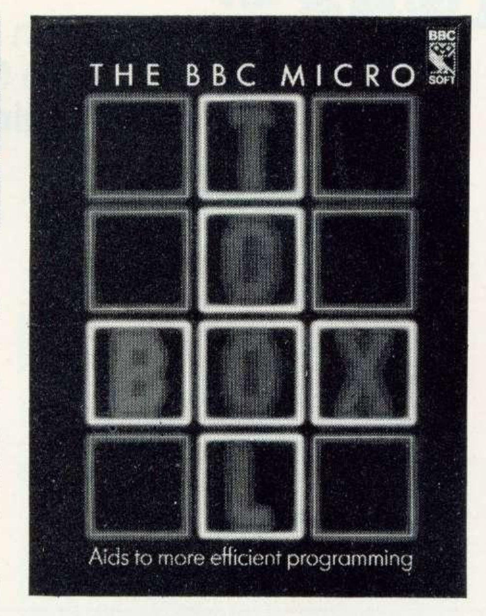
For example, there are six sorting routines; a circle draw and fill; two double-height character generators (one for modes 0, 1 and 4 the other for modes 2 and 5); a machine code graphics dump for the Epson MX80; and a generator to output numbers through the speech chip. All of these can be used in programs without breaching the copyright.

The second group consists of programs, all but two in machine code, to allow various testing and debugging operations on Basic programs, or to allow you to globally alter your Basic programs. For example, there is a cross referencer, which will output lines containing a specific keyword and text (ie it is equivalent to a 'find' utility); a replacer, which will change any part of a Basic program into anything else (eg it will change VARI% to V% throughout the entire program); a packer, which will squash as many lines as possible together into a single line (this is one of three 'squeeze' utilities – the others are a space remover and a REM remover); and a variable dump, which outputs all variables, including arrays, *used* in your Basic program except the static variables (ie A% to z%) – but the program has to be run and all the relevant variables created, for the utility to be used to maximum effect.

The software (on tape) comes with very comprehensive documentation: a 208-page book with full instructions for each utility, full listings for each utility (for the machine code ones, the source code), and clear details on where in memory to put the routines for both tape and disc machines. There is also a section on how to relocate the machine code programs, which unfortunately proves to be a rather messy operation in most cases.

This is a very well-produced and well-thought-out package for the serious programmer, and is highly recommended. I look forward to the second part which is in preparation.

Ian Birnbaum



CHIP COCKTAIL

Transistor's Revenge By Chris Butler, Softspot, model B (any OS), £6.95

TRANSISTOR'S Revenge is beautiful to watch, has nice sounds and is mindless to play. It's a game that really shows BBC graphics at their best.

In the centre of the screen is a large integrated circuit labelled '6502'. From this radiate printed circuit board tracks to the edge of the screen. Various electronic components move slowly and smoothly in along the tracks and occasional fast voltage spikes zip in. You control a cursor in the IC and fire your own spikes along the tracks to blast the components. The controls are responsive and fast, and, with practice, you can send impressive groups of spikes along adjacent tracks.

If any component reaches the IC or an incoming spike hits the cursor, the IC explodes. To add to the interest, every so often, bonus tools appear at the edge of the screen: hammers, spanners, pliers and something like a cocktail cherry on a stick with a piece of gherkin – perhaps it's a software tool.

After you've lost three ICs, you get the chance to either stop or carry on. In fact, it's easier to carry on which adds to the game's mindlessness – you stop caring if you get hit. If you do decide to give up, you can enter your initials.

The transistors, capacitors, resistors, LEDs, spikes and explosions are a joy to watch but unfortunately, the game hasn't much else to offer. Your responses are so limited, there's little to develop in the way of tactics or strategy – it's all a matter of refining your skill. *Transistor's Revenge* is really just a version of space invaders with the aliens coming in on tram lines. It's a wonderful implementation of a poor game, but I look forward to the programmer's next product – I'm sure he's capable of a lot.

Peter Balch

SAVE YOUR MONEY

Mr T's Money Box, Ebury Software, BBC model B (series 1 OS), £12.95

THE *Good Housekeeping* magazine has presumably given its seal of approval to *Mr T's Money Box* from Ebury Software, but it does not have mine!

First, I found it very tedious to load – 15 tape sectors are apparently taken up in just producing the title picture in a ghastly pink colour, and installing the loader. After three minutes loading machine-code programs (tiny print tells you to *RUN the program, not chain it) you are expecting great things, up to *Snapper* standards!

What you get is two games designed to assist the very young in recognition of coins, and in a very elementary way to assist them with money values.

My own experience was that this subject was picked up only too fast by my children without a computer's assistance! There is some supplementary value in the abstract shape recognition involved, but I cannot help feeling this is better learned using real money, or a Mothercare toy shape box.

A program of this simplicity and length should not need an instruction manual to help the parent set it up. All the menu programs should be self-explanatory. Clarity has been sacrificed to Mr T's graphics.

There are odd quirks too. One is that though copper coins appear as red in the full display, both copper and the gold £1 coin are yellow when you have to match them. Now we all know the £1 coin is close in size to both 1p and 2p coins, but it is not difficult to distinguish by eye. Yet Mr T expects you to distinguish between yellow circles differing in diameter by less than 1mm. Another annoyance was a seemingly meaningless collection of coins and Mr Ts which kept appearing at the end of a game. I was unable to discover why.

The graphics are dull, the sound is pathetic. I preferred the failure sounds to the success ones – surely a disastrous teaching point! No, parents. Save your money! Put it in your own money box, not Mr T's.

George Hill



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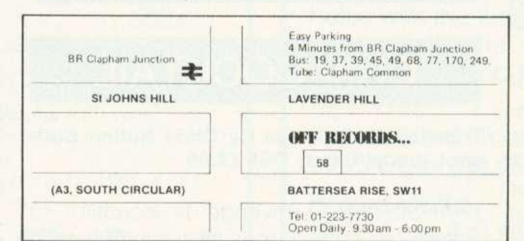
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LAND OF THE BOFORS GUN

3D Bomb Alley, Software Invasion, model B, £7.95

3D Bomb Alley from Software Invasion puts you in charge of defending a fleet of ships. After the title page and instructions have loaded, the main game is loaded.

First, a background graphics screen appears which shows a harbour surrounded by hills, cliffs and a blue sky. When loading is completed the game announces itself with a tune.

To play the game, you have to control the sights of an anti-aircraft gun and shoot down approaching enemy bombers. I found it easy to use the keyboard controls and in no time was hitting planes. When the game begins, you have three ships in the harbour and are awarded a new ship for every 10 planes hit.

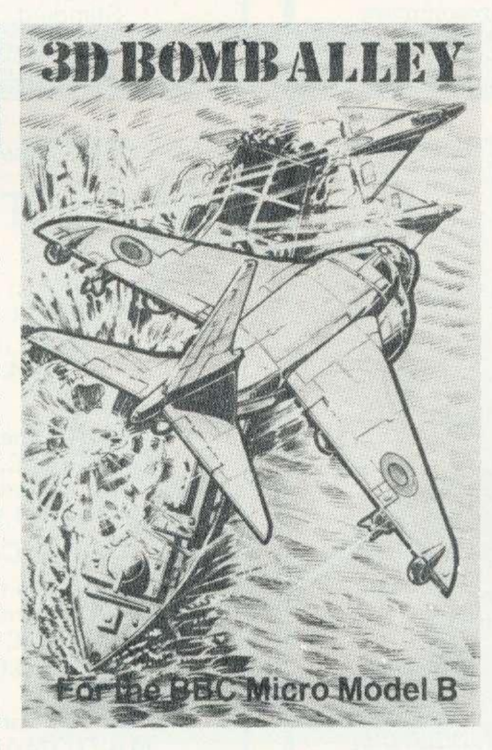
At first, the planes approach one at a time and are easy to destroy, but as the game develops more planes appear . . . and then your problems start. If you fail to destroy a bomber, it will drop its deadly cargo and sink one of your ships. The game is over when all your ships have been sunk.

The ships and planes are well defined, with the planes increasing in size and definition as they draw nearer. They first appear as dots, but soon take shape. The aircraft drone matches the graphics and gets louder as the planes approach the ships.

Keyboard options include sound on/off and a freeze game key, always useful. One minor bug is that if a plane is destroyed at the side of the screen, the explosion spills off screen and re-appears on the opposite side, which detracts from the realism of the game.

That point aside, I found *Bomb Alley* an enjoyable game which is well presented and should provide a few hours of fun.

Paul Richard



MAGIC SQUARES

Number Puzzler, by Mike Thorne, ASK, London House, 68 Upper Richmond Rd, London SW15, £9.95

NUMBER Puzzler loads easily and reassures the user by initially reading a header block which displays the title on the screen. It is important that loading is straightforward because four minutes is a long time to wait to get a 'Bad program' error message.

The program begins with a menu which offers choices of playing *Addition, Subtraction, Adds and Subs* or doing a self test. All responses are by single-key entries except where the user's name has to be input.

Addition is played on either a 3×3 or 6×6 board. The aim is to get three numbers in a line by either using the two numbers given or their sum. Squares are coloured to show who has won them. The screen display is clear and instructions are unambiguous. Numbers seem to be chosen to produce a result and the machine checks for faulty addition. Entries can be changed and the delete key works as normal, even though the characters are plotted as enlarged.

In *Subtraction* a single number can be used as it is, or be split into any two positive numbers which sum to it. This is more interesting and produces better tactics than the simple addition version. *Adds and Subs* allows a mixture of both games with either the numbers being used, or their sum or the components of either. This is played on a 6×6 board (really four 3×3 boards arranged in a grid), and is quite difficult.

The skill level in the next stage, *Magic Square*, is much higher as the program gives a partially completed square. The user enters the remaining numbers and scores by how many horizontal, vertical or diagonal lines add up to the constant for the square which can be deduced from the original diagram. This game can be used at a variety of levels since almost everyone can complete some correct lines and more careful planning is needed to complete a magic square. It is a pity the arrow keys cannot be used to alter values and that there is no way to allow pupils to experiment without being trapped in the procedure of trying to score more than a hundred for the three games.

The self-test is disappointing because the time taken to plot the characters interferes with even a moderate typing speed. A fast typist is either frustrated by the time delay or penalised for 'incorrect' answers. This part of the program does not match the standard of the rest.

The program is specified for children between four and 12, although it could easily be used with low-attaining older pupils. The whole package is professionally presented with an attractive instruction booklet and a simple mechanism to set the sound level to one of five values.

Although *Puzzler* will never be a wildly popular program, it is well worth the money for primary and secondary schools.

Paul McGee

WORD ROLLER

Wordhang, Bourne Educational Software, 32k, £8.97 (£10.99 disc)

HANGMAN programs proliferate for every micro, but *Wordhang* is the Rolls-Royce of them all.

There are several modes of play: individual word entry; use of list files supplied on tape; use of list files created using the *Wordstore* program supplied.

The program is menu-driven and allows the user to choose the length of guessing time. There is also a progress monitoring option to keep a record of the child's skill in spelling and comprehension.

As the child begins to play, the gallows appear – which alarmed some users who were used to having them built as and when they make mistakes. The mystery word is displayed as a series of dashes and a running list of letters already guessed is maintained for the child to see. For classrooms, it would have been an improvement to use double-height teletext characters, but this is a minor criticism.

Use of the same letter twice is not allowed and all illegal keyboard entries are ignored. As the word nears completion, encouraging messages are displayed and the man grows from head downwards as each error is added to the previous one.

The graphics are particularly good – if gruesome! The man smiles all the way up to the last mistake. As his final foot is fitted, his expression changes, his lip quivers and, with a most realistic bouncing, he drops and turns blue! Unfortunately, as is often the case with this sort of program, the reward for failure is more entertaining than that for success.

The child may guess the word at any point during the program, but a wrong guess incurs a three-stage penalty in the man's development.

This is an excellent version of an old chestnut and has obviously been well tested. Apart from the break key, there isn't much to threaten its robustness. Its flexibility in use is going to mean that many people who have used this type of program, especially in the classroom, will have one to cover all their needs.

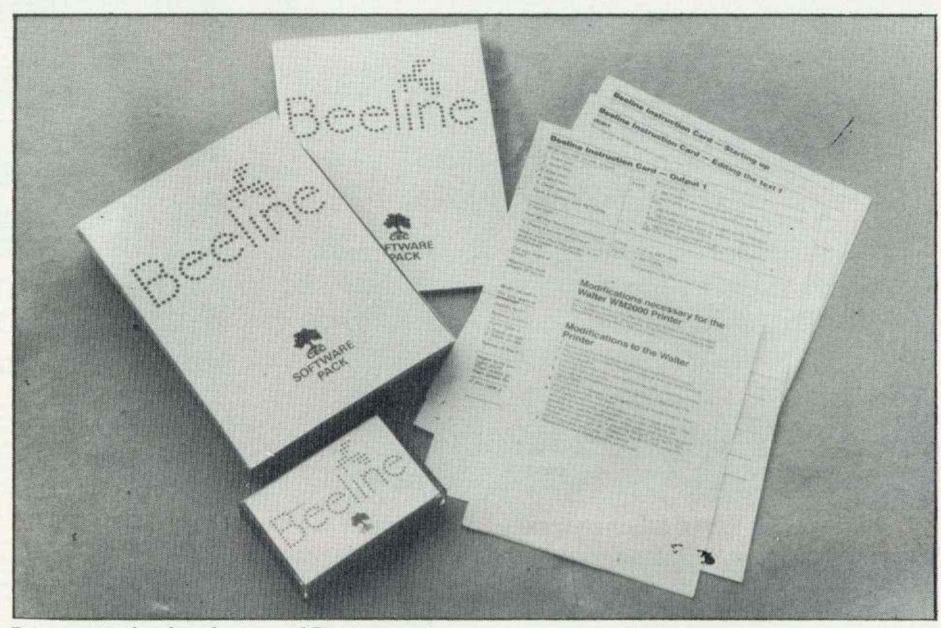
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WORDPROCESSING STARTER FOR SCHOOL AND HOME

Beeline by Ian Birnbaum, EARO Resource and Technology Centre, Back Hill, Ely, Cambridgeshire, for Cambridgeshire Educational Computing, BBC model B, £16 (cassette)



Documentation is a feature of Beeline package

TAPE-BASED word processors, by their very nature, are limited and cannot hope to compete with disc or ROM-based programs. However, use of good programming techniques and a little thought can result in a remarkably flexible compromise. Compromise it must be, because of the limited memory space available after the WP program has grabbed its workspace.

Different solutions to the problem can be seen in the approach adopted by IJK's *Wordpro* and H&H Software's *Alphabet*. The former uses an 80-column mode and limited facilities, the latter uses 40 columns but includes a number of useful block operations and printer facilities.

Beeline adopts a different stance altogether. It comes complete with a detailed manual, a set of instruction cards and the cassette-based program. Disc users need not groan because the publishers have adopted a very positive attitude, providing detailed instructions on how to transfer the program to disc. When used with discs, *Beeline* provides some extra functions.

The *Beeline* system comprises three modes of operation: input, edit and output, which are summarised in figure 1.

Text can be input via the keyboard or the tape (disc) filing system. Before this however, the line length and/or tabulation stops are set (figure 2). This done, an input menu is presented displaying the input selection. Keyboard input takes place initially on a blank screen, and this is where *Beeline*'s technique becomes apparent. No screen rulers, or on-screen formatting here; instead the screen acts as a 10-line 'page', each line being given a number in the left-hand margin. This is a little disconcerting at first, but not to worry, all carriage returns are taken care of.

Long lines automatically break and continue in the correct position – no need to bother with a carriage return (figure 3). As text is entered a new (numbered) screen appears. There is room for about 2500 words, after which the file must be saved and a new one started.

Editing the text is simplicity itself. Pressing the shift and * keys together allows entry into the edit mode. A selection of edit commands appears beneath the text (figure 3), and several useful commands are available. All editing requires the line number(s) to be given so the system can locate the necessary text. The copy key is used to reproduce the line to be edited and the delete key works as usual. Characters may be moved, inserted or deleted in the middle of a line. This is achieved by 'cutting' a line and afterwards 'squeezing' (compressing) the text.

Text may be moved in blocks to another part of the document. Markers are not used, instead the line numbers must be specified. Up to 256 lines may be moved at a time. The edit mode allows for a limited search-and-replace facility. A locate command allows replacement with another word of the same length or shorter. To some extent this is selective, giving the option of altering the search string or not. OUT allows escape from the edit mode and the output menu appears on the screen (figure 4).

If all editing is complete, the text may be printed (option 1). The program asks a number of questions at this point: whether the text has been squeezed, if a printer is

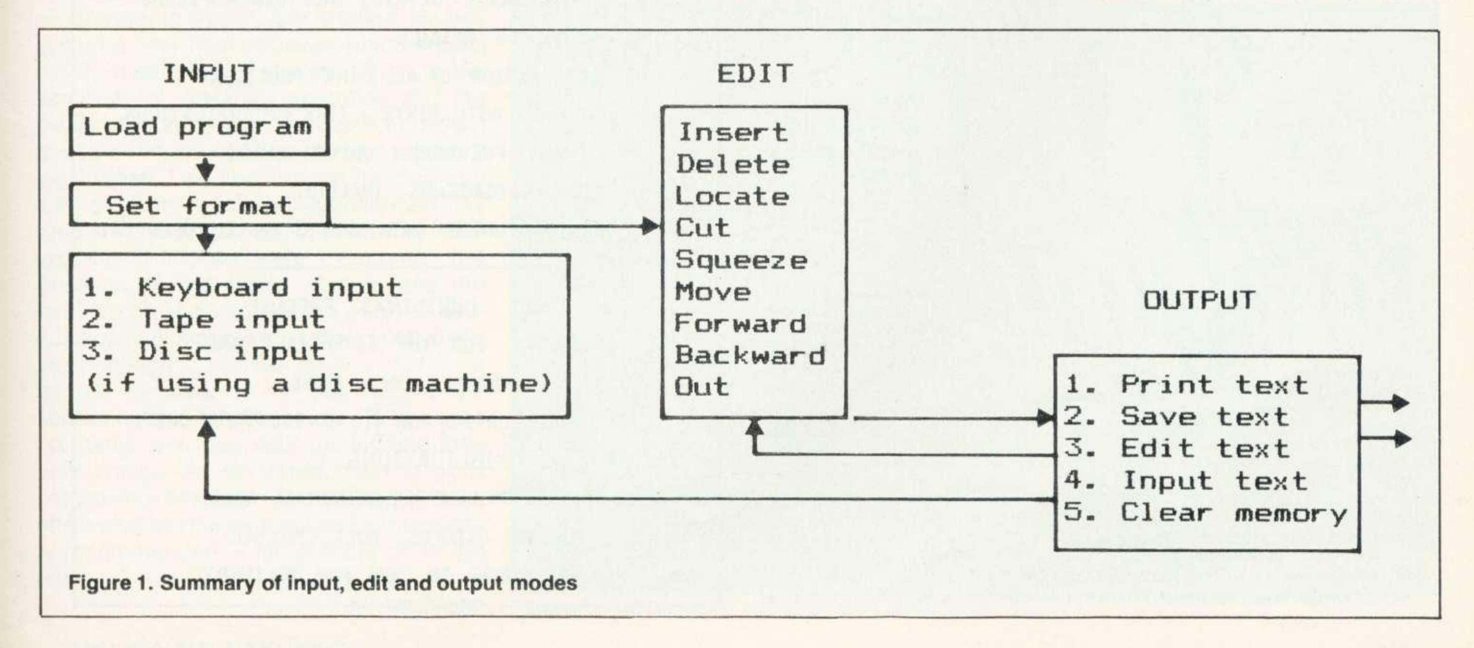
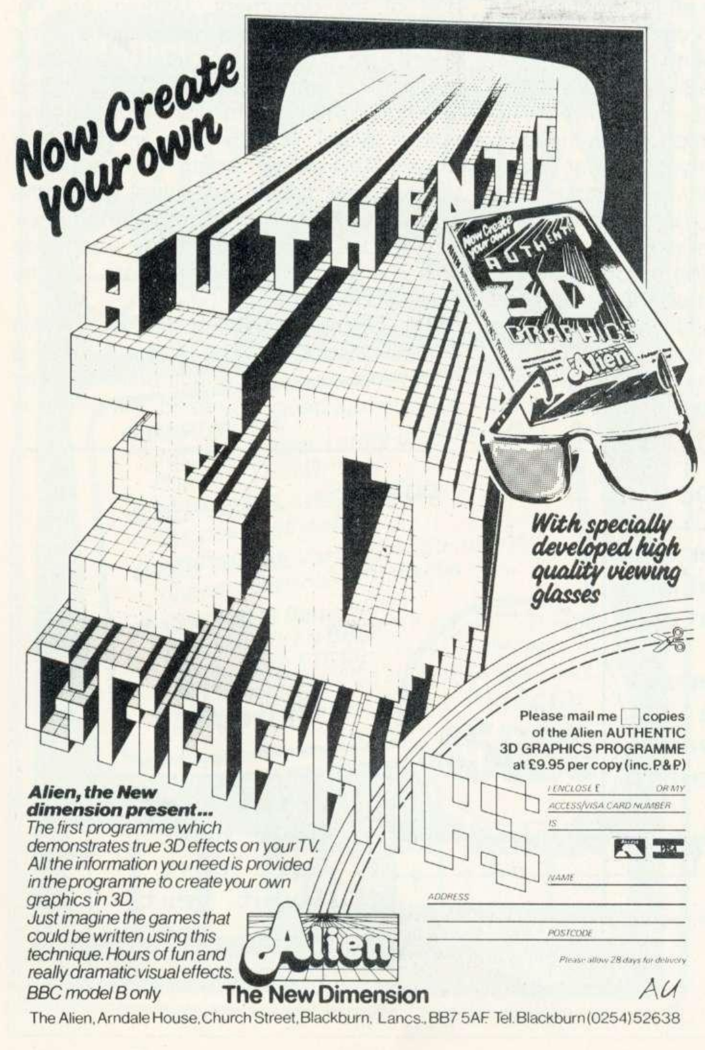


Figure 1. Summary of input, edit and output modes



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attached and paper correctly positioned. Printer line length and margins are set and the options of emphasised printing and right justification of the text are given. Initially, the program is configured to Epson printers. (However, the publishers positively encourage the user to alter the program, and provide details of how to convert it for other printers.) The text now printed may be saved on cassette (or disc), or returned to for further editing.

The program works well and does all it purports to do. I could not uncover any bugs and my overall impression was how friendly the system is. One very pleasing point is that all operations which are fairly drastic in consequence are trapped by a routine which politely asks 'Are you sure?' to minimise accidental loss of text. The author has also (sensibly) trapped the break and escape keys for the same reason. The problem then arises however, of how to leave the program. The only solution is to switch the machine off and back on again. I would have preferred an extension to option 5 (clear memory), to include an exit from the program.

Colour highlights various actions in the edit mode and as *Beeline* is written in mode 7, all text is clearly visible on a television set. Menus are displayed in large characters and are simple and clear. The BBC micro's editing facilities are put to good use, but apart from one instance (key f0 to save cassette files), the function keys are neglected. It would be better if these were programmed to perform some of the edit functions or allow the user to program them with commonly-used words and so on.

The standard of the documentation included is very high indeed, with every instruction covered in a section of its own. The author has thoughtfully included a tutorial in the back which takes newcomers through the whole process one stage at a time. The inclusion of sturdy, laminated instruction cards is an excellent idea.

The program's author, Ian Birnbaum, is no stranger to *Acorn User* readers. He has written a very neat package which should satisfy most of your needs. Such is the simplicity of *Beeline*'s operation and the clarity of its approach it is ideal for children to use as an introduction to word processing. Indeed, I worked through the program with a 12-year-old who experienced few problems writing a story once the initial learning difficulties were overcome. The limitation of not being able to see the formatted text on-screen will exclude serious applications, but then that is not where the package is aimed. It is a matter of 'horses for courses'. If you require the sophisticated functions of ROM-based programs, you pay your money and take your choice. As an introduction to word processing however, *Beeline* really does offer value for money and can be thoroughly recommended – for schools or in the home.

Chris Drage

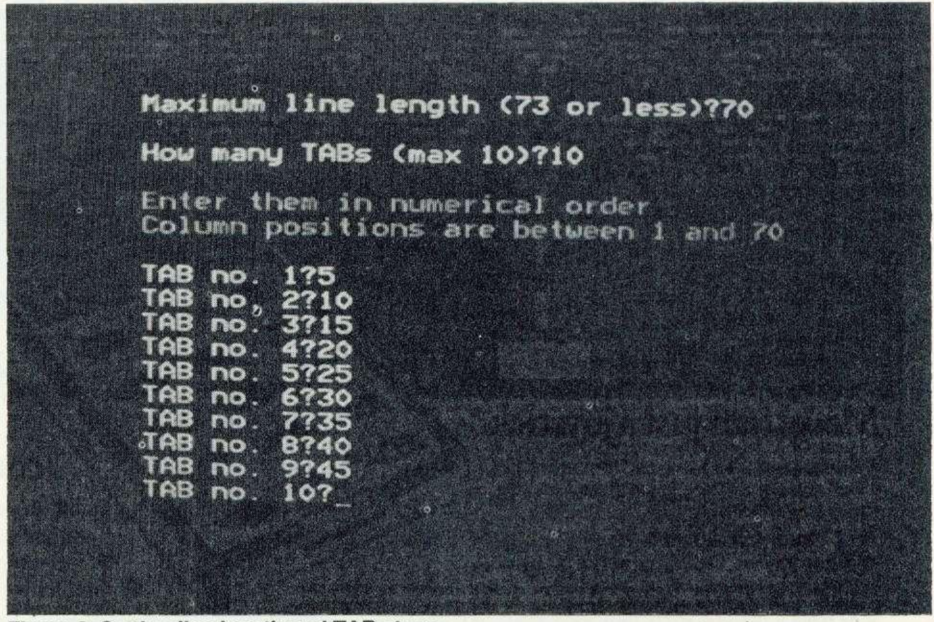


Figure 2. Setting line length and TAB stops

```
0 This a demostration of how BEELINE be
haves in the EDIT mode.   Although
 1 it uses a 40 column display, each lin
e is given an automatic carriage
 2 return after the preset line length i
s reached.
 3

 4 New paragraph...

Edit Insert Cut Delete Move Squeeze
  0    Locate Forward Backward Out  13

   >This is where I pressed the RETURN ke
y
```

Figure 3. Automatic carriage return

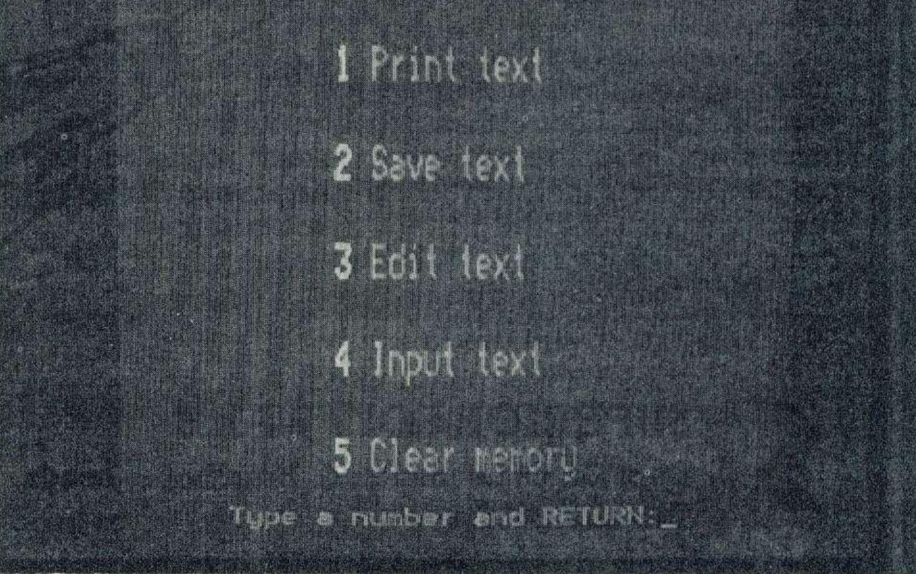


Figure 4. Output menu called by OUT command

BOOKLETS ARE ONLY GRUMBLE

Scales and Transverse Waves, Five Ways Software, BBC, £12.50 each

DESCRIBED as suitable for children of 11 and over, *Scales* is designed to teach pupils how to read a thermometer, a measuring cylinder, a burette, an ammeter, a stop-watch, a vernier and a micrometer screw gauge. It should provide an essential skill for those taking science and some craft courses.

The program loads easily and gives the user a menu from which to choose the required measuring device. Although the accompanying booklet – there is one for both programs – says that the cursor is moved up and down using the U and D keys, the arrow keys work just as well.

A diagram is drawn for each device and the user is asked to input the reading to the correct level of accuracy. Incorrect or null answers (by pressing RETURN) produce an explanation, and pressing f0 gives the current score and the chance to change device.

The vernier and micrometer gauge displays are particularly helpful. The measuring cylinder, however, is hard to read on a monochrome monitor and this certainly demands a different physical skill from that needed to read the real thing. The notes make the point that pupils should have seen the real device in use and should be aware that although the program does not demand units every real application will.

The program is intended for both class display or individual use. For general class use the numbers seem rather small, but the layout, mode of operation and helpful corrections make it ideal for small group use. The program will be a boon to teachers who have found progress of practical work slowed down by pupils who cannot read a scale and who need individual attention.

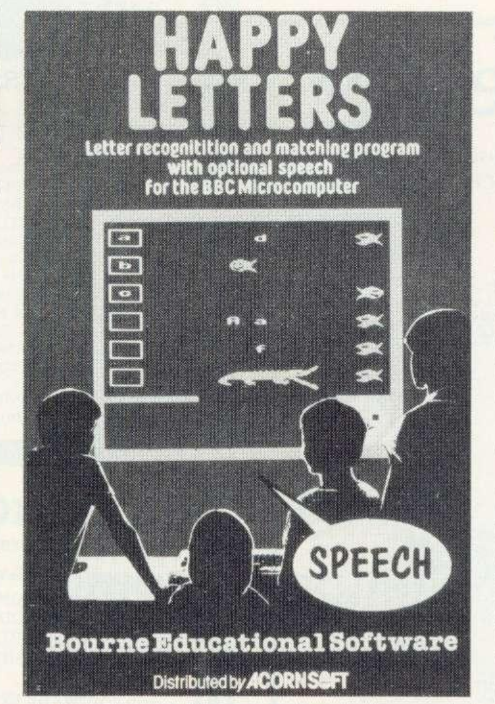
Transverse Waves is for pupils following Physics courses at O level or above. The program covers interference, reflection and beats, all of which can be displayed with a varying number of points, varying speed and the ability to freeze a frame by pressing the spacebar. It is an excellent program that gives endless possibilities for pupils of average and above-average ability.

These programs are robust, the screen displays are clear and uncluttered and they both meet worthwhile educational objectives in an appropriate way. My only criticism is that the brief booklets don't give the average teacher sufficient help to get the best from the programs. A few helpful sample runs showing some of the advantages of using the computer would have been helpful, particularly in the *Waves* program.

Neither booklet gives much educational philosophy and the user has to learn a lot by trial and error. For example, it would be useful to know how *Scales* responds to errors. Does it immediately repeat a question thinly disguised or wait a few turns before repeating it – or ignore the error altogether?

The programs incorporate the Five Ways Software security systems to prevent copying or listing.

Paul McGee



VOICE CHIP MAKES ENTRANCE

Happy Letters, Bourne Educational Software, BBC, £8.97.

HAPPY LETTERS is a comprehensive letter-matching program for the three to five year age-range. Both upper and lower case letters are matched with other upper and lower case letters on the screen or with the keys on the keyboard. An additional facility is the use of the voice synthesis chip (if fitted to your machine) which pronounces each letter to be matched as it appears. It is the *name* of the letter rather than its sound that is produced, which some teachers of reading would frown upon. The program works without the sound option.

The letters to be matched are produced in sixes, alphabetically, from a pre-selected part of the alphabet. This means you can control which area the child concentrates on. The six letters, or words beginning with them, appear in a column and the first letter to be matched jumps down the right-hand side of the, list, begging to be matched. The child responds with the return key when the letters match.

Several attempts are allowed, the final ones prompted by a flashing box around the correct answer. The correctly matched letter then moves into a box on the left of the screen and six angry-looking fish on the right gobble up the letters as they are chosen. The fish return smiling, ready for the last stage of the program.

When all attempts have been made and the fish are either full or still angry, along comes the crocodile. The fish, replenished by the diet of letters, have the energy to swim away while those unfed become the crocodile's meal, usually to the delight of the player. Another amusing feature is the mystical tune from *Close Encounters of the Third Kind*, the audible reward for a correct choice.

Some problems arise when the keyboard choice is used. Here the child matches letters on the screen with the corresponding key. My 3½-year-old found that the mode 5 letters did not match the keys at all. For a non-reading beginner this is not only confusing but illogical, though with practice the child would soon learn to pair them correctly.

Generally speaking, however, the program is well-written, well-controlled and entertaining for the beginner or the reader with letter-indentification problems.

Nick Evans

QUALITY BYWORD

Approximation, Estimation and Standard Form, Five Ways Software, £14.38.

THIS professional, well-tested program comes from a company that has become a byword for quality educational software. In terms of presentation and clarity of instruction there are few competitors.

In each of the three options one is able to select a difficulty level and, in the case of *Estimation*, an accuracy level. Although it is menu-driven, there is a summary of special keys which affect the operation of the program, all of which are clearly indicated in the handbook and program.

As is so often the case with this sort of software, one is often in difficulties deciding whether it should be for class demonstration use or for individual experimentation. Obviously it lends itself to both, but in a classroom one needs a very big screen for single-height teletext characters.

In terms of the actual operation of the program, the student is expected to be able to develop his ability to estimate based on increasing success with the tests given to him. A clear indication of his level of accuracy is shown by a bar chart on the right of the screen.

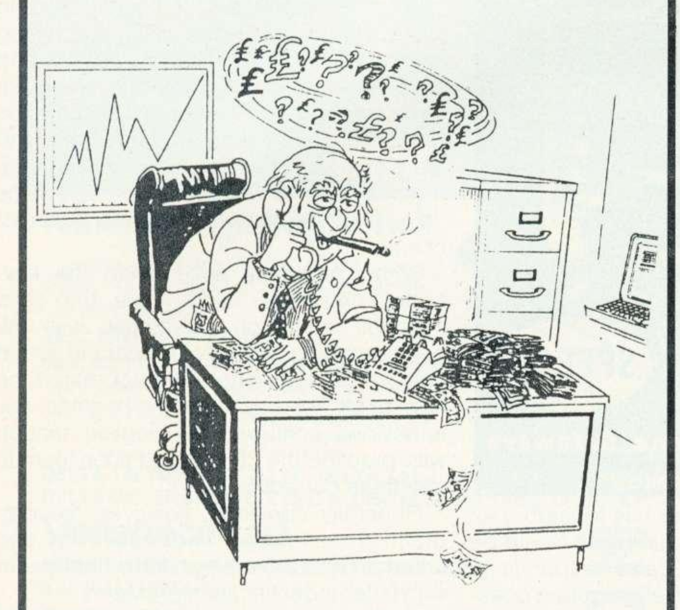
Approximation may be performed to a top level of five decimal places and five significant figures. In *Standard Form*, the student may be asked to convert floating point to standard form or vice-versa.

A straightforward, practical and useful tool for the mathematics classroom.

Nick Evans

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GLUTTONY IN THE GARDEN

Caterpillar, Gemini, BBC 32k (any OS), £9.95

ARNOLD is yet another lovable(?) character to arrive on the software scene. He is a caterpillar with a voracious appetite. We find him in a walled garden full of lettuces (which he likes very much) and coloured, poisonous mushrooms (which he definitely doesn't). Your job is to see he gets fed by moving him around the garden. You must of course avoid the mushrooms and the garden wall which are both fatal. (Everybody say Ah!) By the way, he's a rather noisy eater and he gulps his food.

He has three lives at the start of his journey and you have to guide him through 10 different screens or gardens. The first four are as described above; you get points for the number of lettuces he eats and a bonus if you survive for the time allocated to each screen. As you progress he grows longer (what else would you expect from a glutton?) and he gets faster (presumably from all that energy he stores). This can make the task of keeping him alive very difficult. While you are looking for the next lettuce to aim for it is quite easy to bump into a mushroom or even the wall.

There are no mushrooms in screen five, just a mass of lettuces. Here you just have to eat as much as possible within 30 seconds (which suits Arnold down to the ground). It might sound easy, but by this stage Arnold has almost attained mach 1 and the walls loom larger than life. If you survive this of course you get a special bonus.

Screens six to ten are identical in format to the previous five, except you now have Charlie to contend with. Charlie is not Arnold's best friend, in fact he's a rather aggressive customer (which isn't surprising as you are now eating his dinner). Avoid him like the plague or it's the kiss of death.

The game is well presented, playable and enjoyable. It has good sound and colour, and the animation is very smooth. I would like to have seen a joystick option, as the game lends itself readily to it. However, just four keys are required to control the game and the only thing to remember is that you can't turn back on yourself. Presumably if you did Arnold would bite his own tail off. I was a little frustrated at the response to the keys when Arnold was travelling at a rate of knots. On occasion it didn't seem to pick them up quickly enough, and I'm sure I pressed the right ones.

In all, it's not just another caterpillar game, although that's obviously where its roots lie. *Caterpillar* could be described as an adaptation of various themes, and in this respect it somewhat lacks originality. However, it's a novel little game and for those who like the type it should provide a lot of pleasure.



I never did get through to the final screen (my reflexes must be slowing with age), so I don't know what delights await. Hopefully you are suitably rewarded. My only questions are: does Arnold ever turn into a butterfly? (he should do with the amount he eats); and will Charlie ever have a change of heart?

Ian Rowlings

NO APPLAUSE FOR CRICKET FLAWS

Owzat?, Virgin Games, BBC 32k, £7.95

WHEN I was a schoolboy we used to play a cricket game with a scorebook and two metal dice which you rolled to determine the outcome of each ball. It was my habit to ensure that Ted Dexter, aided and abetted by me at the other end and controlling the dice judiciously, invariably got a double century.

This game is a computerised version of that one. You can select your own teams or use the English/Australian ones provided. You can have automatic bowling and batting or do these yourself (fairly crudely) using the keyboard. You can also decide whether you want a limited-overs match or a full game.

The screen display represents a view from approximately the stands at the mid-wicket boundary, which becomes a close-up if you're doing your own batting. At the end of each over you get the bowling analysis, and at the end of each innings the full scorecard.

Although as a cricket enthusiast I approached the program with some eagerness, I rapidly found it not only dull but downright irritating: what is missing is the attention to detail which cricket fans love. If you're batting and you miss the ball, you're automatically bowled. There is no provision for extras, no column showing maidens in the bowling analysis, no fall-of-wickets on the final scorecard, no run-outs allowed. The bowlers don't change ends after each over and the Australian fast bowler Jeff Thomson needs a 'p'. I grew tired of the large number of sixes scored over the head of third man.

Attention to detail is also missing in other areas. There are no sound effects (why not the sweet sound of willow meeting leather or of the crowd applauding a fine shot?) and you need a magnifying glass to read the instructions.

Virgin got into the software business with a big splash and rapidly acquired a lot of dissatisfied customers. Judging from this offering they still have a long way to go to improve.

Simon Dally

ARCADE MUST

Missile Control by Nicholas Tingle, Gemini, BBC 32k (any OS), £9.95

A FAITHFUL rendering of the arcade favourite where missiles track and branch down the screen. They're after your cities and your missile launchers. You have three bases perched on mountains left, right and centre, plus six cities to protect. You aim missiles by placing the cursor in the path of one or more enemy missiles and selecting the appropriate fire base using f0, f1 or f2 (or if you press shift the program selects for you the nearest base to the target). The cursor is moved using the arrow keys; A and Z can optionally be used for up and down.

As you can gather, some degree of manual dexterity is called for, but if you have a joystick, select J and life's a lot simpler.

At the end of each raid, the surviving cities and remaining missiles are totted up. On wave two, planes and satellites fly by dropping more missiles in their wake; on wave six, smart missiles that dodge your missiles make an appearance. The game ends when all six cities have been knocked out, and you'll have to endure a nasty stroboscopic 'the end' display that seems to last for hours. Get on the scoreboard and you're treated to a famous Cliff Richard tune (not Summer Holiday). Up to four players can play together in turn. A must for arcade action freaks, it's also available for the Electron.

Alan Pipes

OVERPRICED AS CLASSROOM AID

Chemical Analysis, Acornsoft, £13.80 (£17.25 disc).

THIS suite of three programs, designed for the 14 to 16 age range, deals with the major areas of chemical analysis in broad terms: elements, inorganic and organic.

The basic format for each of the programs is the same; the machine randomly chooses from a data list the substance upon which tests may be made. A list of possible tests is put on the screen for the student to make his choice. As each test is performed a small amount of text, recording the result of that test, is put into the 'answers' section. Every time a further test is made, the results of the previous tests are still visible. It is possible to give up by pressing the escape key and then the choice of quitting the program entirely, starting again or seeing the answer to the previous test is given.

The problem with the programs is that, although similar, they are not identical in operation. Now it's unlikely that a student will study all three at once, but it is confusing when conventions accepted in one program do not apply to another. For example, when a test had been performed on a substance, that test was highlighted in green to make it obvious the choice had already been made. Apart from the fact that green makes no noticeable difference on a green monitor, I was surprised to realise that this rule did not apply in *Elements*. Whether this was an oversight I don't know.

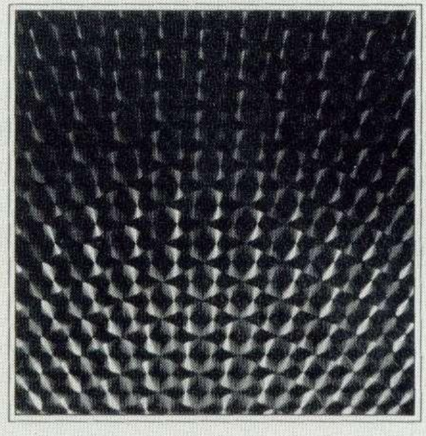
On a similar, and possibly equally trivial point, spelling such as 'gasses' and 'disolves' also had one wondering about the speed of production of these programs. Moreover, again in *Elements*, the answer did not appear when you followed the escape routine, which was most frustrating.

The range of tests often seemed inadequate, especially on the higher levels of *Elements*, since when one is dealing with the full breadth of the Periodic Table, elements that are close to each other are necessarily similar in properties. It was at this point that the range of tests seemed to fail – particularly when dealing with metals. The same comment in general terms could be applied to all three programs to a greater or lesser extent.

Another disturbing point was that there was no 'descending' of the numbers in formulae.

As a revision aid this program would probably be quite useful and constant use would enhance the student's basic knowledge of these three areas. However, as a classroom aid it is limited and seems overpriced for what it is.

Nick Evans



ZX GRAPHICS

Firehawks, Postern, BBC model B, £6.95

DOES the world really need more space invaders? Well, whether we need them or not, Postern had given us them. This isn't quite the standard invaders though, the Firehawks appear singly and in groups from the top of the screen and have to negotiate various fixed patterns of shields.

After each wave of Firehawks, a new shield pattern is drawn. At first, they come in slowly – they seem to hover waiting to be shot and get caught behind the shields – later, they come in more quickly but never show signs of intelligence. The last Firehawk on each sheet is very much faster, and so difficult to hit. In later sheets you're left feeling that the program has cheated.

The tape loaded successfully every time with three programs – a title and fanfare, some terse instructions and the game itself. The cassette cannot easily be copied to disc as it contains several protection mechanisms; however, a disc version is available.

The graphics of the game are disappointing – they make the BBC look like a Spectrum. One 12-year-old's reaction was 'what's that – a flying Haggis?'.

The controls are difficult: 'Z' and 'X' move your base left and right at such speed that we had no fine control even after practising for several days. There is no joystick option. You get a choice of the starting sheet and the speed of the Firehawks. The sheets count backwards from 15 but we never reached zero, so I can't tell you what happens.

Personally, I prefer *Swoop* or *Arcadians* but, if you're looking for a new challenge, *Firehawks* is an interesting version of an old favourite.

Peter Balch

EXCELLENT BOOK ON ASSEMBLER

Beyond Basic: 6502 Assembly Language Programming for the BBC micro, by Richard Freeman, BBC/NEC, price £7.25 (cassette £11.50)

THIS package consists of a book – 256 pages (could this be significant?) and a cassette of the programs which are used as examples within the book – 81 programs in all plus a Title program which is similar to, but even less inspiring than, the Intro program which comes on the Welcome cassette. Having said that, however, the contents of the actual book are really excellent.

The book is in the same series and uses the same techniques as the NEC book *30 Hour Basic*. It aims to lead you into the world of assembly language programming by getting you to do practical exercises, with the emphasis strongly on 'hands on' and 'brain engaged'. Each chapter contains self assessment questions with answers, carefully stated objectives, and an assignment.

The book is spiral bound like the *User Guide* which makes it easy to use. It is well set out and makes good use of green and black printing and different typefaces, though some of the diagrams contain hand written titles which make it a little untidy in places.

The programs are well presented, using lower case for variables names and labels, and using lots of comments.

Ten chapters cover: number representation – hex and binary notation; addition and subtraction; jumps, loops and branches; addressing modes; multiplication and division; lists and tables; the stack, CALL, USR and masking; operating system calls; tough stuff – 16 bit multiplication and division, plus sorting a Basic array; round-up – a useful final section on hints and tips, and errors to avoid.

Two complaints come to mind. First, in an exhortation to follow the text methodically at the beginning of the book, the author says that if you don't the only way to find points you miss is through the index – but there isn't one! (Mind you, I suppose that just emphasises his point.) Second, since the BBC has such a powerful operating system it seems a shame more use is not made of it in teaching the basics of assembly language programming. I find that students are more excited by writing a machine code program to draw lines on the screen and change colours, than to add and subtract hexadecimal numbers.

Despite the complaints, I think it is an excellent book and have already recommended it to a number of people, and will continue to do so.

Paul Beverley

ELECTRONIC MONOPOLY FOR THE WHOLE FAMILY

Pass Go by Kay Dee Software, BBC 32k, £12.

THIS delightful program is similar to the famous Waddington game of Monopoly (a picture of a Monopoly-type board appears on the box) but has some interesting refinements.

Up to nine players can participate and the object is to drive the opposition into bankruptcy. Each in turn moves round a 'board' – on the screen this is represented as a car with the player's name on it cruising past various buildings while a jolly jingle emerges from the loudspeaker. What happens next depends on which building you come to halt in front of. . .

Each player starts with £15,000 cash and, as in Monopoly, the art of survival depends on steering a fine course between maintaining enough cash to pay your debts and buying enough property to ensure an adequate income. If you stop in front of an hotel or store you can buy it (if it's for sale and you have the cash available). If it's already yours you can sell it or improve it (which increases its rental value). Of course, if someone else owns it you have to pay out rent.

Sometimes you land on Chance, when more or less anything can happen: jail (which you can buy your way out of) or, more agreeably, Salary, which gives you a cash sum based loosely on the amount of property you own. There are also banks which will sometimes lend you money, depending on your assets.

Another feature is the Market, where you can buy and sell commodities in the form of shares, land and gold. The price of these varies considerably during the game and there are real killings to be made, as well as shirts to be lost.

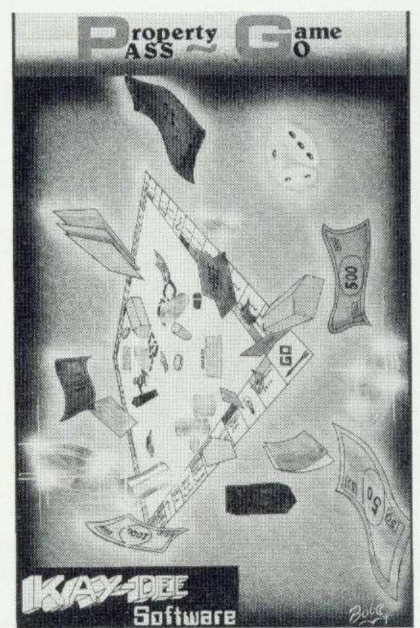
At the end of a turn, each player's personal balance sheet of cash and other assets is shown. Light-fingered Monopoly players in the habit of snitching a few hundred quid from the bank when no one's looking will get no joy from this all-electronic version!

I tested the game *en famille* one Sunday and it lasted for several hours. It is a measure of the careful thought which has gone into it that, though one can dispense with the graphics and sound, no one grew tired of them. The participants were: yours truly, a left-wing sister (who took to this most capitalist of games with alarming enthusiasm), a plutocratic brother to the right of Genghis Khan, and a disobedient but decorative dalmatian puppy called Pimms, whose main talent is her ability to recognise the rustle of a packet of crisps at several hundred yards – and to take appropriate action. We jointly took the decisions for Pimms during her absences on crisp-hunting forays. . .

The first two hours produced little of incident but were totally absorbing. My left-wing sister concentrated steadily on acquiring property (despite her claim that all property is theft), while the capitalist brother, after an initial disastrous attempt to corner the gold market and ruin another player (something the program doesn't cater for) also prospered. Alas! I began to find it cheaper to sit in jail and collect my rents than to move around the board. It became clear that the more property you own the more revenue you receive, but the more lolly you have to fork out for things like gas, electricity and telephone.



Jeremy's marker lands on one of the less-pleasant delights of Pass Go



If you're faced with a bill you don't have the cash to pay, a debt collector steps in and forcibly sells some of your assets,first deducting his own 15 per cent of course.

My sister became incensed when she received a Chance message saying: 'Ex-wife sues, pay £2,500'. 'Typical sexist nonsense,' was her comment. Meanwhile my brother was more annoyed that you can't buy a bank in this game as he had some 'interesting' economic theories he wished to try out on his fellow players. His other complaint was that the car you drive around in looks more like my own battered Renault 5 than the Mercedes he felt he deserved.

I have three main criticisms of the program. First of all, it needs a printed rulebook. The rules are on the tape, so you can't refer to them during a game. Next, there should be a facility to save a game to return to it later: most adventure games allow this.

Finally, when a game ends you should have the chance to start again without having to reload the program (a lengthy process).

These comments apart, this is one of the more impressive games I have seen for the Beeb; it should appeal to families who enjoy playing games together and who would like to sit around a computer or introduce someone else to the joys of a computer.

The outcome of our game? Pimms won, of course. It's a dog's life.

Simon Dally

WHITE KNIGHT SPEED TELLS OVER CRAFTY ACORNSOFT

White Knight Mk11 by Martin Bryant, BBCSoft, model B (OS 1.0 onwards), £11.50
Chess by Arthur Norman and Nick Pelling, Acornsoft, model B (OS 1.0 onwards), £9.95

IN THE March issue, the three chess programs then available for the BBC micro were reviewed. Since then two others have been released, one from Acornsoft (at last – this was expected nearly a year ago) and one from BBCSoft. The original article gives details of the tests which were done. However, in case you haven't read it, the six positions with which the programs were tested are shown again.

The Acornsoft program, simply called *Chess*, comes in the familiar, well-packaged style and the BBCSoft box is almost identical. Documentation in both cases is very good, a six-page and a twelve-page booklet respectively. Unlike some of the arcade-type games, the picture on the front of the Acornsoft box is a true representation of the screen display. The BBCSoft program is *White Knight 11*.

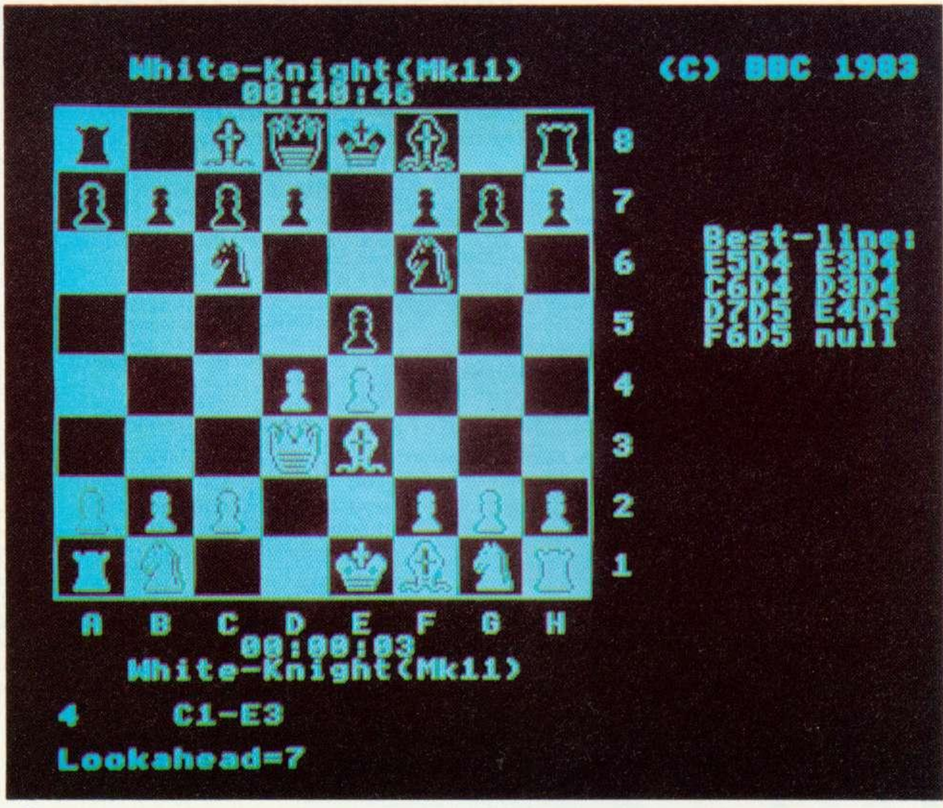
Chess has a main menu and an editor menu which makes it easy to use and after a while the booklet becomes superfluous. *White Knight* has less helpful information on screen, so reference to the booklet is needed, especially on returning to the game after using another program. Both have all the facilities needed for normal play and for setting up problem positions, clocks, and the ability to save and recall games. The displays of the board and pieces are good, particularly the Acornsoft version, and compare well with the three older programs. As well as showing the last few moves, *White Knight* also gives the current best line found, the ply being searched to and, at the end, displays the number of positions examined. This latter information disappears rather quickly.

Chess and *White Knight* allow moves to be entered either by keying in the from and to board positions in normal algebraic notation or by using the cursor keys to select the positions on the board. *Chess* can also use joysticks, but in both games setting up a position is very easy.

Levels of play are set differently. *Chess* has ten levels from 0 (easy) to 9 (very difficult), while *White Knight* levels are based on time – average move time may be set up to 59 minutes 59 seconds. It can be set to play at the same speed as its human opponent. Both programs have a special mode for chess problems to reach mate in so many moves. Mate in five moves, is allowed ie, nine-ply – potentially very powerful, but see later. None of the earlier programs had this feature.

Like the earlier programs neither of these have an opening 'book'. They seem to prefer knight openings and are soon away from the standard lines. However, their opening moves are usually quite sound.

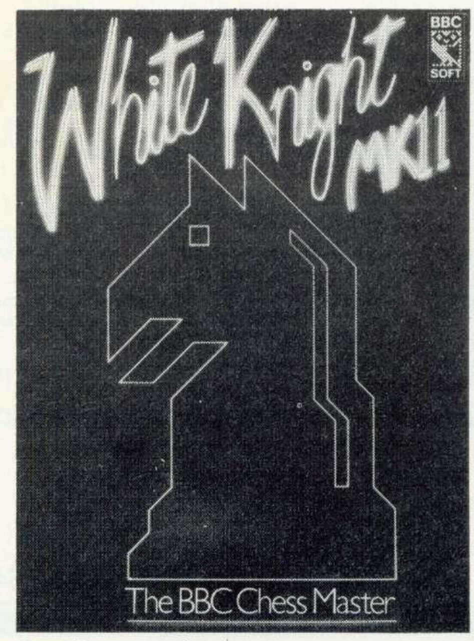
As explained in the earlier article, set problems as published in chess books are a good test of how well chess programs play. I have used the same set of problem benchmarks as before with a few additions.



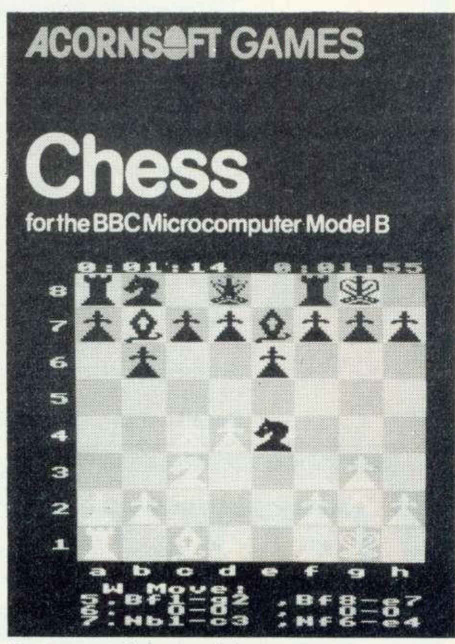
Screen shot from White Knight

Mate in two moves (three-ply): Each program was given nine problems. The best of the earlier programs (Program Power) solved all nine correctly in times from ten seconds to eight minutes. *Acornsoft* solved all nine in problem mode in four seconds to just over one minute – considerably faster than Program Power. White Knight solved them all in problem mode in less than one second each! Figures 1 and 2 are two of these problems. Solutions are: A4-E4 check, B7×E4; D3×E4 mate; and D5-A8 check, C8-C7; A8-B7 mate respectively.

Mate in three moves (five-ply): Program



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Menu options available are:

B — Copy to buffer on/off: All input from the host may be copied into a memory buffer which is approx, 23K in mode 7.

L — Load buffer from current filing system file for transmission to modem.

S — Save buffer to current filing system file for 'browsing' later.

V — View current buffer contents on screen — display speed may be varied, or paused with optional dumping to printer.

T — Toggle screen mode : normally mode 7, 80 columns available in mode 3.

O — Output buffer to modem — speed may be varied to suit particular modem speeds.

M — Issue any MOS command from within COMMSTAR eg. *FX8,3 (ie set RS423 baud rate).

C — Exit menu to 'chat' mode to allow conversational access to bulletin boards.

W — Wipe buffer prior to use of other buffer commands if necessary.

E — Echo on/off — set echo on when using host terminals which do not provide an echo.

X — Toggle XON/XOFF protocol.

R — Reset buffer pointers.

I — Initialise RS423 port for word length, parity and stop bits.

F — File transfer using XMODEM protocols. High integrity via use of enhanced 'Christiensen' protocols.

Commstar also contains its own software clock in memory which is useful in displaying length of log-on time etc.

Details of the above products can be obtained from your nearest BBC dealer or direct from:



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Power was the only one of the earlier programs considered good enough to tackle these. Its times were 49 minutes for one problem (figure 3) and nearly three hours for another, both solved correctly. Acornsoft did the first one in 35 minutes. *White Knight* – this is the amazing thing – did this one in 15 seconds! It did other mate-in-three problems in six seconds, 13 seconds and 19 seconds. The solution to figure 3 is: E8-H8 check, H7×H8; E3-H6 check, H8-G8; H6×G7 mate.

White Knight was so good that it was given three mate-in-four (seven-ply) problems. It solved these in four minutes, eight minutes and 10 minutes. Any of the other programs would have taken hours.

Both the new programs were faster solving problems in problem mode than playing normally. For instance, for one of the mate-in-two problems Acornsoft took 24 seconds in problem mode and needed level four to get the correct answer in over two minutes. *White Knight* took one second and four seconds respectively.

Now for the special problems in figures 4, 5 and 6. Both Acornsoft and *White Knight* failed to solve figure 4. The answer is to let black promote the pawn, exchange it with the queen, then easily win with the four-to-nil pawn advantage. The answer to figure 5 is to promote to a knight rather than the usual queen, thereby forking the king and queen. Acornsoft was correct, *White Knight* was not, presumably because it is programmed only to promote to a queen.

Figure 6 shows an endgame pawn-king race situation. In this case the king cannot catch the A-pawn before it promotes but can catch the B-pawn. So the answer is to advance the A-pawn. *White Knight* could not solve this even at its highest level. Acornsoft solved it at level six in 30 seconds. Bug Byte was the best of the earlier programs, solving it in 24 seconds.

On this occasion I had no access to a chess machine so could not try actual games. Playing them myself would have been too variable – I am a very inconsistent player!

To summarise, there still isn't a perfect chess program for the BBC micro. *White Knight* is fast, particularly in problem mode. The display shows it to be examining positions at over 50,000 per minute! It has its limitations as mentioned above, but I would still rate it as the best buy. I would rate Acornsoft and Program Power about the same as second choice.

The problems were taken from *How to Get the Most from Your Chess Computer* by Julio Kaplan; *The Computer Chess Book* by T Harding and *Rate Your Own Chess* by F Donald Bloss.

John Vaux

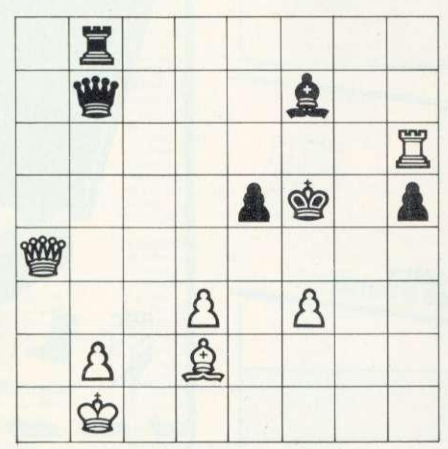


Figure 1. White to move

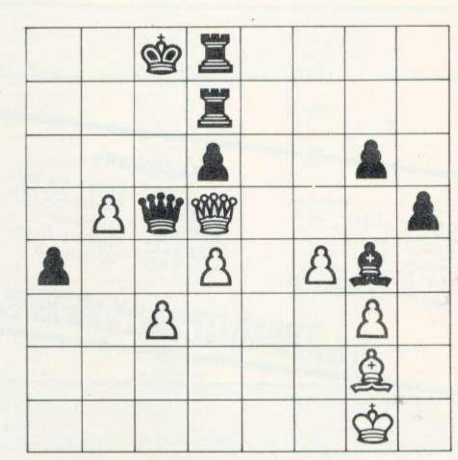


Figure 2. White to move

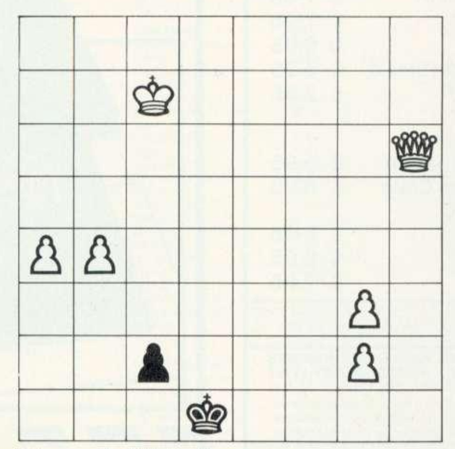


Figure 4. White to move

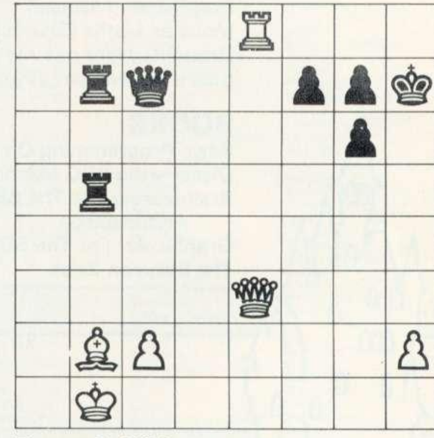


Figure 3. White to move

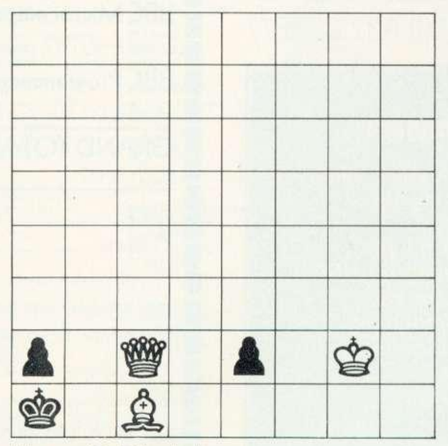


Figure 5. Black to move

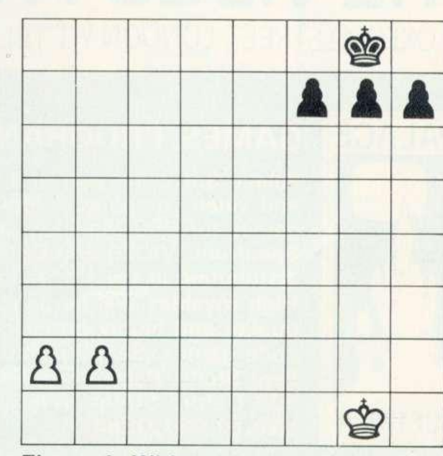


Figure 6. White to move

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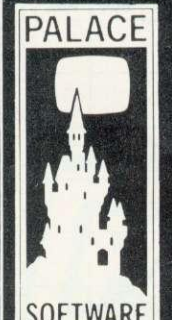
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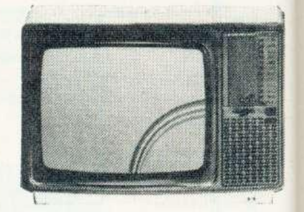
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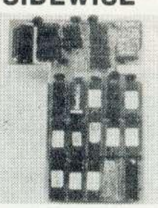
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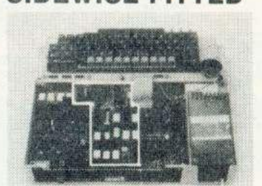
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SIDEWISE

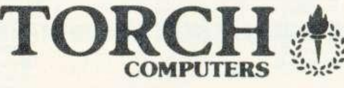


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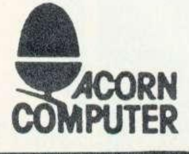
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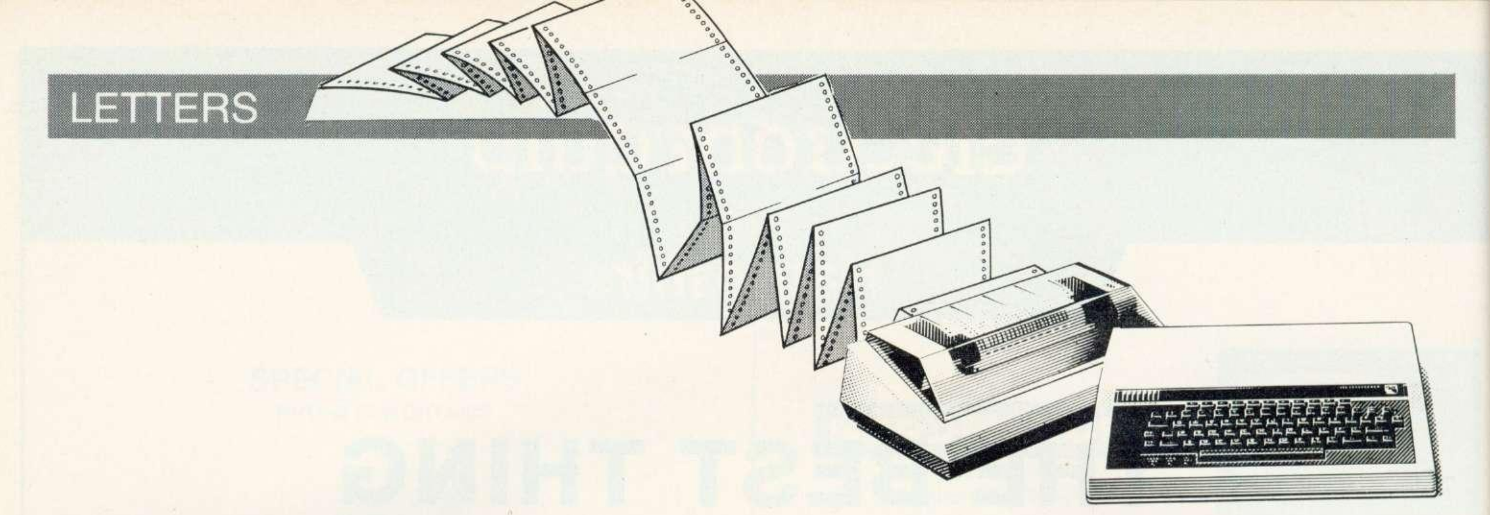
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MINIMUM POSSIBLE

Sir, May I congratulate you and Stan Froco on drawing attention to the existence of the so-called NP-complete problems, such as the travelling salesman and knapsack problems, which are fairly easy to specify and to program straightforwardly but whose naive solution would be practically impossible because of the computing time required.

Your readers may be interested to know that such problems are of great practical importance, for example in the placement of circuits on chips and in their wiring, particularly in a large mainframe computer where one might wish to keep connections short (to reduce signal transmission time) yet not too densely packed. A radically new, powerful yet simple procedure for the resolution of such problems has recently been proposed and demonstrated, based on a computer model analogy with the physical process of annealing that a metallurgist uses to produce a relatively defect-free alloy.

The object of the exercise is to minimise something – the distance travelled by the salesman, the space unoccupied in the knapsack; we call this the cost function. The quantity we change is called the configuration; for example, the order of the cities visited by the salesman. It would be prohibitive in computer time to calculate the cost function for every value of the configuration. We must find the minimum *without* such a calculation.

It is easy to minimise the cost functions of problems for which from any starting configuration we can make small changes so that we reduce the cost function each time, eventually reaching the unique minimum. NP-complete problems do not have this property – rather, if one imagines a graphical representation with the cost function as the height, one has something more like a mountain range with many peaks, valleys and cols of various heights.

From an arbitrary starting point one cannot reach the lowest valley by only going downwards; one must go over intermediate cols. In fact, there are usually many 'lowest' valleys of similar height, any one of which would be acceptable, but all have secondary valleys and cols of different sizes on the valley sides, inhibiting a systematic descent to the floor.

How can one find one of the lowest valleys without knowing anything about the overall terrain and in a reasonable (not NP-complete) computing time?

The key idea was provided last year by three IBM scientists. It employs a Monte Carlo technique in which the system tests random changes in its parameters, accepting downward changes but also upward ones with a reduced probability. Initially, upward changes are allowed fairly readily so that the system can get over some of the higher cols, but this probability is gradually reduced until finally the system is in a low valley. More precisely, upward changes are allowed with probability given by exp $(-C/T)$ where C is the change of cost function and T determines the ease of such changes.

This is precisely the procedure nature uses in changing the microscopic state of a solid (or liquid or gas) where now C is the change in internal energy and T is the absolute temperature (except for a multiplicative constant). When a metallurgist anneals an alloy he starts at high temperature and gradually cools it. So here one performs an annealing simulation, starting at fairly high T and gradually reducing it. As a rough rule of thumb, at 'temperature' T one can overcome barriers of height $C=T$.

This procedure is currently being evaluated and applied at many laboratories and appears to have great potential, particularly for complicated and large problems. It has already proven itself on problems such as the travelling salesman, bi-partitioning of the IBM 370 microprocessor and repackage of the chips of the IBM 3081 processor. More details of background and applications can be found in the very readable article by its inventors S Kirkpatrick, C D Gelatt Jr, and M P Vecchi in *Science* vol 220, page 671 (1983).

Professor David Sherrington
Imperial College of Science
and Technology
London

OFF TUNE

Sir, I use my BBC model B with a Grundig domestic television set. I have reserved a channel for the microcomputer, but when I first switch on the picture is not satisfactory.

The set has an automatic picture-search facility. When I use this facility, it is not able to find the optimum output from the computer. I am, however, able to adjust the picture manually and therefore I can usually obtain a reasonable picture.

Can you explain why the television set is unable to 'find' the best output from the computer? Is the output from the computer different in any way to television programmes broadcast over the air-waves and fed to the TV from an aerial? The television is always able to find the best TV picture on any channel.

Nigel Webley
W Yorkshire

Generally, microcomputers do not produce a VHF output of nearly as good quality as broadcast television. The set is adjusted to lock on to only very good signals, and that from the computer is simply not good enough. When you tune normally, *you* choose what picture is good enough, so the problem doesn't occur.

IN THE PICTURE

Sir, I am loyal subscriber to *Acorn User* and admire the presentation of the magazine. However, please note the points below.

Your review of the *Hobbit* micro-cassette filing system (September issue) was regrettably superficial. I have been told by a Nascom user of the same drive unit of its incredible reliability. 1 in 10^9 bit error rate (cf, floppy disc 1 in 10^6), yet your review suggested otherwise.

Could future reviews be more comprehensive both in technical detail and discussions of user applications environments?

Your discussion of the Beeb Teletext adaptor was interesting reading and gave much useful information, as do also your news items. However, photographs would have been worth many extra pages of print: an open-top view of the board, connections etc, alongside Beeb view.

Similarly, in your news section, more photographs of the items being discussed are longed for.

What does the Beeb ROM socket look like? A view of the board with the Speech chips in place, pictures of the second processor, a picture of the SWR extension boards on sale and possibly in situ – and so on. Perhaps small points, but a feast for the Acorn user's eye and mind. More encouragements to go and buy?

Keep up your high standards.

M Davies
Wirral

COLOUR SCHEME

Sir, I find your magazine excellent value, as a beginner. The 'Painting by texture' article of McGregor & Watt (September issue) was particularly fine and I have dared to make a small addition, enclosed, which might be of interest. The two extra procedures are added between lines 40 and 50 of program 1, page 32 (as amended in program 2, page 35).

The effect, if you will excuse my amateurish programming, is to permit you to choose the three basic colours, in PROCchoose colour, then print a small 'palette' showing the 15 combinations which can then be used in the painting.

Since adopting this, I have had many hours of pleasure.

Secondly, an annoying problem. With my first experience with the Commodore Pet, where the printer is specially made for it, dumps were easy, so I bought an Epson FX80, which has no dump for my BBC micro. Programs for the Epson MX80, given in earlier *Acorn Users*, did not work. An Epson technical writer finally kindly converted one of them for me, so I have a basic dump for Mode 1.

But why was it necessary? Coming from an older age, as you might suppose, I am staggered that the modern computer age can make such a mess of a seemingly simple procedure!

D Fry
Kent

You have to remember that the Commodore Pet was sold as a complete system with VDU, drives and printer included. The concept of the BBC micro, however, is one of total expandability, which allows you to choose from a much wider range of add-ons. Remember, too, how much the Pet cost.

As far as printer dumps go, the program in the December *Acorn User* is designed to print all the BBC's modes on any Epson bit image printer, and so should work on both MX80 and FX80.

```
1090DEF PROCchoosecolour
1100PRINT"Enter three basic colours"
1110PRINT"(1.Red 2.Green 3.Yellow 4.Blue"
1120INPUT"(5.Magenta 6.Cyan 7.White )",colour1,colour2,colour3
1130VDU19,1,colour1;0;19,2,colour2;0;19,3,colour3;0;
1140CLS
1150ENDPROC
1200DEF PROCdrawpallette
1210RESTORE 1500
1220FORN=1 TO 10
1230READ a,b,c,d
1240MOVE a,b:DRAW c,d
1250NEXT
1260RESTORE 1600
1270FOR N=1 TO 15
1280READ e,f:MOVE e,f:mix=N:PROCsppaint(e,f)
1290NEXT
1330ENDPROC
1500DATA 0,1000,600,1000
1510DATA 0,900,600,900
1520DATA 0,970,600,970
1530DATA 0,930,600,930
1540DATA 0,1000,0,900
1550DATA120,1000,120,900
1560DATA240,1000,240,900
1570DATA360,1000,360,900
1580DATA480,1000,480,900
1590DATA600,1000,600,900
1600DATA100,980,200,980,300,980,400,980,500,980
1610DATA100,950,200,950,300,950,400,950,500,950
1620DATA100,920,200,920,300,920,400,920,500,920
2000DEF PROCsppaint(e,f)
2010PROCfillfrom(e,f)
2050ENDPROC
```

D Fry presents two procedures to give better colour control

XREF BLOCKED

Sir, I have a model B micro with 1.2 OS and have just keyed in the XREF program in the November issue of *Acorn User*.

I have used INPUT# and PRINT# in other programs, together with LOAD and SAVE, and have never experienced any problems with cassette file handling – having the volume level on my Smith's CCR800 set at 1½-2.

However, running XREF against program files on cassette, I found that BLOCK? errors kept occurring for the BGET# command at line 550. Turning up the volume control helped get past one such error, only to encounter a repeat further on. Trying to find an optimum setting resulted in either BLOCK? or DATA?

As written, the program doesn't allow recovery from such an error, so it became quite frustrating having to start again. I amended the *OPT command at line 100 to *OPT2,1 which then gave the option of a rewind back to the beginning of the block without having to restart the entire run. Additionally, it should be possible to incorporate error handling to cater automatically for such occurrences.

I am interested to know if anyone else has experienced this problem on byte handling and whether there is a remedy.

Simon Holland
Hastings

XREF STOP-GAP

XREF users (November) will find there is a problem with certain tape recorders. When a program is saved, the operating system uses a 0.6second inter-block gap. XREF can only read files if the tape recorder in use is capable of stopping and restarting the tape within this gap. Unfortunately, the inter-block gap cannot be altered for save; however, the attached program *Copy* will save a program (which can be loaded or chained in the normal way) using a 2.5 second inter-block gap.

Copy is used as follows:

Load or enter the program to be copied.
Type PAGE=HIMEM−&200
Load or enter *Copy*.
Run.
Enter the file name for the copied program.
Start the tape recorder.
When the copy is finished reset PAGE to &E00.

XREF can then be used on this copy of the program.

Ian Graham

```
   10 REM COPY for XREF,Acor
n User,November
   20 REM Uses inter-block g
ap of 2.5 seconds
   30 REM rather than standa
rd 0.6 seconds
   40 REM with BBC operating
 system
   50 I%=&E00
   60 *OPT1,1
   70 INPUT"Program name ",A
$
   80 F%=OPENOUT(A$)
   90 REPEAT
  100 BPUT#F%,?I%:I%=I%+1:E%
=?I%
  110 BPUT#F%,E%: IF E%=&FF
THEN 140
  120 I%=I%+1:BPUT#F%,?I%:I%
=I%+1:L%=?I%
  130 FOR J%=4 TO L%:BPUT#F%
,?I%:I%=I%+1:NEXT
  140 UNTIL E%=&FF
  150 CLOSE#F%
  160 END
```

Ian Graham bridges the inter-block gap

XREF TRUE

Sir, Thank you for the very useful utility XREF in the November issue.

Unfortunately there are still some bugs left in it. PROCassembler is not working correctly, ass% is not reset, and if the assembly code delimiter is the first character, it will be missed.

My suggestion is:

640 ass%= TRUE : IF B%=93 GOTO 660

660 IF B%= 93 THEN ass%= FALSE:PROCread

J Rye
Ipswich

TAB TASK

Sir, For some time I have been using a technique which performs virtually the same task as George Hill's item 'The key to tab' (page 65, October *Acorn User*). Although my method does not produce the same number of spaces as set by @% or move to the next column, it only requires two simple commands rather than using up memory and altering the OSRDCH vector. I list the method below:

*KEY0"   "<cr>; (required spaces)
*FX219,128<cr>

Osbyte call 219 sets the TAB key to produce the code passed in X (128 in this case). The function keys produce codes in the range 128-137, so to use key 4, for example, X would be 132. Thus the TAB key can simulate any function key.

I keep this as a !BOOT file on my disc used for machine code programming and I have found no need for producing the set number of spaces.

Many thanks for a most informative magazine.

Julian Blythe
Cornwall

George Hill replies:
Your neat suggestion is useful, but does not do the same as my TAB program.

TAB should advance the cursor to the next pre-defined column, independent of the present position of the cursor. Your suggestion accomplishes the function SPC, ie, to insert a fixed number of spaces between the end of the last item and the beginning of the next.

To illustrate the difference, look at the output from program 1. My program produces output like the TABbed line, yours like the SPCed line, but with a constant number of spaces.

You say that you use your program to write assembly language programs. If they are to finish up in neat columns for label, instruction and comment fields you must have to use the delete key a lot – or always use labels of the same length, and avoid comments.

Incidentally, there were two reasons for writing the TAB program. One was to accomplish the TABbing function to lay assembly language programs out properly, the other was to illustrate the method of intercepting the vectored calls – a fairly advanced idea, which bears further study.

WRITE OF REPLY

Dear Mr.Hill,

I am writing with reference to your article in the July '83 issue of "Acorn User" magazine.

I am an owner of the GP-100A printer but please don't think this is a letter of complaint! The review was very good and informative, and I definitely agree with you about the noise it makes!

The reason for writing is that there is a small error in your article which I thought should be clarified. In the third paragraph you state that this printer is "a conventional dot-matrix printer with seven dot wires" which is incorrect. The printer head is of the "Uni-hammer" design which means that there are no 'dot wires' in the head at all. What is inside is a vertical plate with a thin "edge", which would in fact always print just a vertical line on the paper if it wasn't for the hidden piece of 'magic' behind! This is a rotating drum which has raised points on it, each running down it's entire length; ie. horizontally when viewed from the front. This means that when the hammer strikes the paper it will only leave a "dot" where the raised section of the drum is behind the paper. Although this gives rise to a slightly inferior print quality when compared to true dot matrix printers, it is considerably cheaper to produce and arguably longer lasting.

I also agree with you about the shape of some of the letters. As you say this is due to the printer not producing true lower case descenders. It was because of this that I decided to try and improve the look of the printout. The end result is what you are now reading. It is probably not 'business' quality but I think that it is an improvement on the original; and where else can you get a 'handwriting' style printer for £215!

All of the letter shapes are held in data form within the program and the printer is used in the graphics mode. As the letter writing is done in mode seven on the screen I have been able to include the Teletext symbols; ←↑→‖÷¼½¾. Another benefit is the ability to get both the # symbol and the £ symbol on the printer at the same time. I recently added an underlining facility as well which takes account of lower case descenders automatically.

Yours sincerely,

Mr. M Clark

Mr.M.Clark,

```
   10REM Using TAB and SPC
   20MODE3
   30PRINT'"Using TAB function"
   40PRINTTAB(0);"A";TAB(10);
"BC";TAB(20);"CDE";TAB(30);
"FGHI";TAB(40);"JKLMNOPQ
RSTUVWXYZ";TAB(60);"END."
   50PRINT'"Using SPC function"
   60PRINTSPC(0);"A";SPC(10);
"BC";SPC(20);"CDE";SPC(30);
"FGHI";SPC(40);"JKLMNOPQ
RSTUVWXYZ";SPC(60);"END."
   70END
```

```
>RUN

Using TAB function
A         BC        CDE       FGHI      JKLMNOPQRSTUVWXYZ   END.

Using SPC function
A          BC                    CDE                              FGHI
                                        JKLMNOPQRSTUVWXYZ
                                                            END.
```

Program 1 and output

40/80 QUERIES

Sir, I have been using the 40-track to 80-track copier from the August issue of *Acorn User* to copy a couple of 40-track discs. Please could you explain the following points?

What does OSWORD with A set to &7E do?

I have been able to work out most of the disc commands through FND, except for the one called in PROCset. I can find no mention of command &7A in my 8271 data sheet, although I suspect that it is the command to write to a special register with R% determing the 'current track' for the surface in use. My data sheet gives this command as &3A.

I suspect that line 610 has been omitted from the listing and should read

610 = X% ? T%

I think it would be very helpful if you could produce an article describing these new OSWORD calls, and any other details of the DFS which people, like me, who do not have Acorn discs and therefore an Acorn manual are unaware of.

William Smith
Sheffield

OSWORD &7E returns the size of the current disc. This facility is provided by the DFS ROM, not the MOS.

Command &7A is synonymous with command &3A but with the select 0 bit set, which selects the required drive surface. The command sets the current track, as you suggest.

Line 610 has indeed been omitted.

POWER SHARING

Sir, An increasing amount of software is becoming available in ROM or EPROM and there is only limited space in the Beeb to fit them. As the system can support up to 16 sideways ROMs several firms are now producing add-on sideways ROM boards to allow for all 16 ROMs to be fitted at once.

I am a little concerned about whether the power supply can take the extra load of all 16 ROMs in addition to my disc drive, which is already powered from the power outlet of the micro. Presumably, if I converted my single drive to a double drive this would further increase the load.

A dealer I have spoken to thought that it should be alright, but didn't seem to be very sure. Could you please let me know if 16 ROMs and dual disc drives (modern slim-line type) are likely to overload the PSU of the BBC micro?

Michael Lowe
Loughton, Essex

We would not recommend that 16 sideways ROMs are added to a BBC micro with discs because the power consumption of this amount of memory is far greater than that available. The solution is to buy a separate power supply unit for the ROM board or disc drives.

COPY PROBLEM

Sir, I have a Beeb with a single-sided 40-track disc drive. I have been giving a lot of thought to the subject of backups. Backing up to another disc with only one drive is tedious, to say the least.

I have come to the conclusion that the best solution is to have a program to enable backing up a whole disc to tape one file at a time, with no operator intervention required. This method is full of problems, as I have discovered. For a start, all files need to be *LOADED and *SAVED to take into account the different types of files.

I think a combination of your automatic menu program (September Hints & Tips) to get the file information from sectors 0 and 1, and tape to disc transfer (April Beeb forum) in reverse would provide some of the answers.

I would be very grateful if one of your readers could give me the answer.

Malcolm Andrews
Trowbridge, Wilts

COUNTER CRASH

Sir, I am writing to inform you of what could be a bug in the BBC computer. When using AUTONUMBER in any mode other than mode 7 I found that the machine will count away quite happily for so long and then for no apparent reason will suddenly begin counting from line 10 again.

Unless this resetting of the counter is noticed it is possible to unknowingly begin to erase the very program that you are typing in.

Is this a bug, or do I have a faulty machine?

J Revis
Leeds

It seems you have a faulty machine. The problem has not arisen in tests carried out by Acorn.

UNWANTED DIN

Sir, Your readers may be interested in a possible cause of tape load/save errors.

One particular brand of tape recorders, being sold under several different names specifically for computer use, has a DIN connector which the handbook recommends is used. The problem is that the microphone is not cut out of circuit by the DIN plug, so any noise nearby comes out as an overlay on the computer recording.

This can easily be checked by talking into the tape recorder while recording a program, and then listening to the playback. The remedy is to insert a dummy jack plug into the microphone input socket.

Dealers could help potential buyers by checking their stock for this feature and warning purchasers of such offending items.

D Stiles
Bristol

DISC DISPATCH

Sir, I am sure that I am speaking for the people who own an Acorn Atom machine when I say that we must seem to be like long-forgotten, second-class customers!

My local computer dealer, Electroniquip of Fareham, placed an order on my behalf for an Acorn Atom disc-pack: this was done at the beginning of March this year. Despite the many assurances of prompt dispatch of this expensive item by Acorn, still nothing has happened, and I am writing to you as a last resort, having made several telephone calls to the customer service department.

If the likes of Dr R Flinn, who works for the University of Birmingham (June *Acorn User*) are having problems with delivery dates where does it leave individual Atom users?

D Bourner
Fareham, Hants

COLOUR QUEST

Sir, I understand that I should be able to use my 14in television set (Panasonic model TC 431 GR) as a colour monitor for the BBC model B, connecting the video outlet socket of the computer to the video in socket of the television set.

When I have tried this, the picture is clear in black and white but I cannot get colour. However, I can get a colour picture by connecting the aerial out of the computer to aerial in of the television set, but the definition is not so good.

How can I get colour on the video input? (The television set has three input sockets: the aerial, the video in and the audio in.)

T James
Chippenham

If your micro has an issue 1, 2 or 3 board fit a 470pF ceramic capacitor between the emitter of Q9 and the base of Q7. Both Q9 and Q7 are transistors near the modulator. The emitter is marked with an 'e' on the PCB in white/yellow lettering; the base is the central leg.

With boards of issue 4 and onwards, fit an insulated wire link between the two holes of S39, found next to the video out socket.

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We continue the invasion this month with our latest and most exciting release yet. Have you the courage to enter the VORTEX? — You'll need all your senses and co-ordination tuned to perfection to avoid being fragmented by asteroid storms or vaporized by aliens. Each second you remain intact, your velocity will continue to increase as the vortex draws both you and all the surrounding debris into it's clutches. The point is inevitably reached where even your super human reactions are too slow to avoid collisions with asteroids, and your ship is destroyed with a blinding flash and a cascade of radioactive particles. This is definately our best game yet, from the author who created Gunsmoke, 3D Bomb Alley and Attack on Alpha Centauri. VORTEX uses keyboard or joysticks, with the option of sound effects and a pause control. (Seat belts recommended but not included!) The true three dimensional illusion will captivate your senses, as you come face to face with the VORTEX. A 3D space voyage for the BBC micro model B for just £7.95 on cassette or £11.95 on disc.

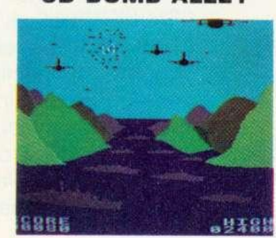
Other programs available for the BBC Micro Model B:- Cassette £7.95 inc. Disc £11.95 inc.

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SECRET DOOR

Sir, I recently purchased a model B with a Wordwise chip for use as a word processor and added it to an ordinary black and white television and a cassette recorder. I couldn't afford a printer but a friend promised to let me use his any time I liked.

However, I then purchased from W H Smith a Silver Reed EX42 portable electronic typewriter. I wondered if this might be converted into a printer but was told by Silver Reed, which does an interface (the I/F44) for its EX44 machine (which is nearly twice the price of my EX42), that this was impossible. But I noticed in the front of my machine a little trapdoor. On opening this, I found a connector. I bought the I/F44 interface and – lo and behold – I now have a printer at a considerably reduced price.

I have checked all the EX42s I can find in local shops: they all have the connector.

When I contacted Silver Reed about this, they claimed I was doing the impossible and implied that I was not telling the truth. When my computer shop manager phoned them, there was a pregnant pause.

Now, I'm a writer, not a computer buff – I don't know a Centronics compatible interface from a 36-pin connector (receptacle), but I do know I've got both and they efficaciously operate my good but comparatively inexpensive typewriter. So someone, somewhere, has made a Big Mistake and if any readers want a cheap, but effective, daisywheel printer, the above tells them how to do it.

Martin Booth
Somerset

SPLIT THE ATOM

Sir, Barry Pickles suggests there are some 40,000 Atom users.

I bought an Atom two years ago but have hardly used it, mainly because I have little spare time to type in long programs copied from magazines which do not specify whether they are suitable for Atoms and what size memory is required, and I have little money to spend on cassettes from advertisers who do not bother to state what machine the cassettes are for (BBC A or B, Electron or Atom), let alone what size memory is required.

I flip through your magazine and despair. In 95 pages of magazine there are two pages relevant to the Atom and they are beyond me. Can you not cater for idiots such as myself?

I am looking at issue No 11 (June '83), pages 14 and 16. Will that bubble sort program run on my Atom? Why can't you use a REM to say, for instance, 'Suitable for Acorn Atom 2k' to help people like myself? And your general articles on interrupts, graphics, etc – which machines are they relevant to? Why can't you keep the magazine in sections: BBC, Electron and Atom?

I see adverts like 'Practical programs for the BBC & Atom', a book advertised for £5.95. Does this imply that BBC programs will run on an Atom? I cannot for the life of me understand that a person with an Atom would want BBC programs and vice-versa. Who can afford two machines; let alone master them?

I see that Garland Computing is advertising some superb educational programs for the BBC, eg, Seed Germination, Blood Circulation etc. Is there no similar, simpler type of program available for the Atom? Is the Atom incapable of handling such programs, or is it that programmers just don't write for the Atom any more? Can somebody please help me?

Mrs P Gough

PS. Perhaps it is true that computers and women were not meant for each other, and that I should sell my Atom in your personal ad column. Would I be any better off if I bought an Electron?

FORMAT FAILURE

Sir, Having read the erudite questions and answers appearing in your column during the last months, I have hesitated to pose my mundane problem. However, I wonder if you or your readers would help.

An OS 1.2 ROM was fitted by my local Acorn dealer to my BBC model B micro, which originally had OS 0.1.

I have failed miserably to obtain a screen display which uses the right-hand column and, say, 23 rows. Ordinarily, when a character is printed in the 40th column the cursor moves to the next line and receipt of a 'new line' character results in double-spacing. The obvious solution should be to add a semi-colon (see line 70 in TEST program). It is this semi-colon which is giving trouble.

As the simple program and the resulting printout show, the screen displays the first six lines as expected. Then the computer inserts six spurious spaces after 260 characters and 250 characters alternately.

To my mind there seems to be an association with blocks of 256 bytes. Have I discovered my own private bug, peculiar to my OS 1.2 ROM (unlikely), or is it shared with all those who use a 1.2 ROM?

Les Fountain
Ferndown, Dorset

The problem you are encountering is based on the fact that the pseudo-variable COUNT is only one byte long, so if more than 256 characters are output without a carriage return ';' the counter overflows, causing mis-formatting – as in your example.

To avoid this, ensure that you print a carriage return before 255 characters have been printed.

QW TO AZ?

Sir, Last year I bought a BBC model B for my personal use, which I would like to start using as a word processor for my company.

The typing will be done by my secretary, who is used to an Azerty keyboard and the Qwerty from the BBC gives her many difficulties.

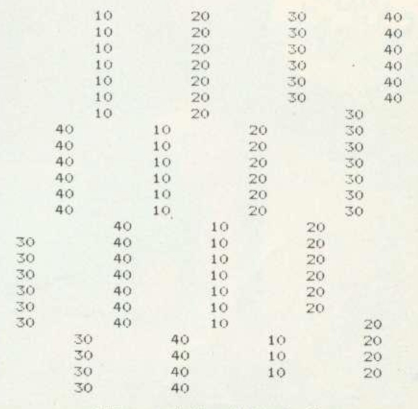
How can I change the Qwerty keyboard to an Azerty one? Changing the keys is no problem, for they can easily be lifted off and put on another location, but is it possible to redefine the hexadecimal ASCII codes, or should any chip be changed on the keyboard?

T Marres
Belgium

The keyboard layout can be changed permanently only by modifying the MOS chip – which clearly cannot be done by an average user – or by major hardware modifications. Keys can be redefined by means of software, as Simon Berry demonstrates in his article this month on creating a 'numeric keypad', but converting the keyboard is not really a practical proposition when you are using a commercial software package, as the word processor is liable to be overwritten by your conversion program.

```
10 REM TEST
20 A=10
30 B=20
40 C=30
50 D=40
60 FOR J=0 TO 22
70  PRINT A,B,C,D;
80 NEXT
90 END
```

Les Fountain's program to test the screen display . . .



```
        10        20        30        40
        10        20        30        40
        10        20        30        40
        10        20        30        40
        10        20        30        40
        10        20        30        40
        10        20              30
    40        10        20        30
    40        10        20        30
    40        10        20        30
    40        10        20        30
    40        10        20        30
    40        10        20        30
          40        10        20
30        40        10        20
30        40        10        20
30        40        10        20
30        40        10        20
30        40        10        20
30        40        10              20
      30        40        10        20
      30        40        10        20
      30        40        10        20
      30        40
```

. . . and the printout that shows a failure in formatting

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DISPLAY PROGRAM

The main control program contains a 'Display' program which enables the user to freely mix visuals in their own programs.

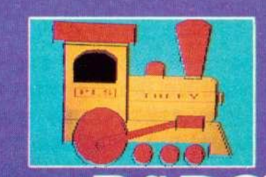
ACCURACY/SPEED

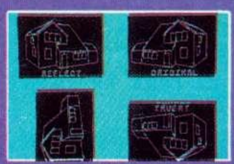
Probe position is continuously displayed on the screen and fidelity of image to original drawing is excellent. Completed images can be recalled from file and dumped to the screen in seconds.

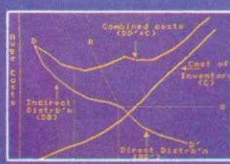
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DIM SPACE

Sir, In the October *Acorn User*, Michael Johnson posed the problem of redimensioning arrays in BBC Basic. This is a tricky little problem if the storage space used in the previous array declaration is to be re-used.

The approach to this problem is to clear the variables back to those which were defined at a previously specified point in the program. This part-clearance can then not only be used for redimensioning arrays, but also for recovering variable storage space after the temporary use of variables. The 'temporary' variables are all the new variable names (except A% to Z%) used after vartop is saved with a DIM V −1 statement.

See, for example, line 30 of the test program below, when OLD_VARTOP is set to the value of vartop immediately prior to dimensioning the array A. PROC_CLEAR in line 60 then clears all the variables which have been first named between lines 30-60 inclusive, that is array A and J in the program as written. Lines 40 and 50 print array A to show it exists and lines 70 and 80 permit you to check whether it exists after PROC_CLEAR. Enter "A(0)" to confirm that array A has gone or RETURN to redimension A.

To follow the workings of PROC_CLEAR, a knowledge of variable storage between LOMEM and vartop is needed (see *Acorn User*, July, page 39). However briefly, the variables are held in chains identified by the first letter of the name, with each stored variable starting with a two-byte address pointing to the next variable in the chain.

The chains are started using initial addresses stored at locations &400+2*ASC (first character of name), and terminated with a zero address vector.

Lines 120 to 140 set A% in turn, to address each variable chain. Lines 150 and 160 update A% to point to each variable in the chain until the chain ends or uses RAM above the procedure parameter V%. B% then contains the address of the required last member of the chain and its address "hi" is set to zero to fix it as the last member in line 170. Finally, in line 180 vartop is reset to V%.

There are two situations when PROC_CLEAR could misbehave. First, I am unclear as to the effect of PROC_CLEAR if used with a second processor across the Tube; perhaps someone would like to comment on this. Second, if existing string variables are lengthened between setting vartop and PROC_CLEAR, they might become corrupted after PROC_CLEAR. The way to avoid this (and to save space) is to set the 'permanent' string variables to their maximum length when they are first used. Any new string variables named between setting vartop and PROC_CLEAR are deleted along with the other variables by PROC_CLEAR.

Jack Pike
Bedfordshire

```
   10REM Partial clearance of variables
   15REM by Jack Pike
   20INPUT"Array size",I
   30DIM OLD_VARTOP -1,A(I)
   40PRINT'SPC(9)"I"SPC(8)"A(I)"'
   50FOR J=0TO1:PRINTJ,A(J):NEXT
   60PROC_CLEAR(OLD_VARTOP)
   70INPUT"Print variable named",A$
   80IF LENA$ PRINTEVAL(A$):GOTO70
   90GOTO20
  100DEFPROC_CLEAR(V%)
  110LOCAL I%,A%,B%
  120FOR I%=&482 TO &4FB STEP2
  130IF I%=&4B6 I%=I%+8
  140A%=I%
  150REPEAT:B%=A%:A%=?A%+256*A%?1
  160UNTIL A%<LOMEM OR A%>=V%
  170B%?1=0:NEXT
  180?2=V% MOD 256:?3=V% DIV 256
  190ENDPROC
```

Jack Pike's test program clears variables back for redimensioning arrays and recovering variable storage space

ECONET SOFTWARE

Sir, Woolwich College ordered, in good faith, 20 BBC micros for use on two Econets. These were delivered at various times over the past year and have been set up ready to test at the start of this term, in early September.

We took the precaution of ordering the Econet software early, in June 1983. there was then *no mention* from Acorn of any delay in getting the software. We fondly hoped, in our ignorance, to have the system up and running in September for use throughout the current academic year.

It is now November and no sign of software. Are our Econets white elephants?

I feel, as so many people have in the past, conned by over-hopeful advertising. Nowhere in their literature lauding the Econet did it say that it would not be usable until 1984 (and then only in very limited form, without such important things as file handling from the stations).

I would be grateful for a response from Acorn to this complaint. I am sure that Woolwich cannot be the only college or school in this unenviable position.

George Hill
London

DRIVE JUMP

Sir, I would like to bring to your attention a fault in the dual-catalogue program in the October edition.

If it is executed on a newly formatted disc in drive 0 of a double disc drive system, have caution when using it in drive 1. I had a very important disk in drive 0 completely ruined. I inserted my dual-catalogue disc into drive 1, logged on to the drive, and typed *ALT. The computer jumped to drive 0 and erased my catalogue!

Colin Millerchip
Cheltenham

See December's issue, page 157, on this point.

FRED-LESS

Sir, I read the letter from Tom Boyd in your October edition about FRED, the memory-mapped input/output area, and his associated spaces.

I too had this problem and started dabbling with character codes. I found that I could redefine code 32 to be anything, a block of white being best. It is then impossible to copy spaces.

However, to activate the new character, I found it necessary to run the program first (the redefiniton is done using VDU 23).

H Hollingworth
University of Essex

BACK ISSUES

July/August The first issue. Articles on drawing techniques, the BBC Computer Programme, machine code graphics, questions and answers, hints and tips, sound, interfacing scientific instruments, dumb terminals for 0.1 machines, disc drives, econet in schools.

September Ceefax telesoftware, Beeb in business, mailing list, simple files, 30-hour Basic course, art on a micro, music, BBC micro as a keyboard, extra Atom commands, BBC Basic board, ULA design, teletext graphics, machine code graphics, analogue input, schools training, 0.1 cassette bug patch.

October Electron details, BBC TV series—confessions, two Epson graphics dumps, Seikosha GP 100 dump, worldwide networking for BBC micro, garbage handling, voice ROMs, sound pitch envelope, moving graphics, ZX printer for Atom, RGB colour separations for Atom, biofeedback, book reviews.

November Teletext, second BBC TV series, machine code series 1, programming forum, Trek III, speeding up graphics, Bomber game listing, 7-tone Epson graphics dump, Atom graphics manipulation, dumb terminal for 0.1 machine, firework graphics, editing tips.

December BBC TV in schools, machine code 2—registers, programming forum, program generators, carols, hints and tips, Logo and turtle graphics in schools, introduction to procedures, software review, Atom word processing, toolbox review, 16-colour graphics on model A, sorting, sound envelope design.

January MEP school launch, *FX commands for sound, second BBC TV series, machine code 3—two pass assembly, disc drives for the Beeb programming forum, program protection, micros in schools—new series, Commodore Pet printer used with Beeb, BBC programs written on an Atom, extra Atom memory.

BACK ISSUES of magazines are available (except July, February, March and April) for £1.25 each from BKT (address below), which includes postage. Please make cheques payable to Addison-Wesley Publishers Ltd. For issues which have sold out we offer a photocopy service (right).

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AU18

USER GROUPS

□ **Belfast** Computer Club, described by hon sec Patrick Roddie as 'Beeb orientated', is being set up and new members are asked to take a computer if possible Meetings are on the first Monday of the month at 7-10pm at the Ashby Institute, Stranmillis Road, Belfast 9. Contact Mr Roddie on Holywood 3212.

□ A new club has been formed in **Surbiton** for Atom users. It meets on alternate Monday evenings at Charrington Bowl, Kingston Road, Tolworth, Surbiton, Surrey (contact Andy Nicholls on 01-337 2696 during working hours).

□ The **Southampton** Amateur Computer Club has its main meetings at the Medical Sciences Building, Basset Crescent East, on the second Wednesday of the month at 7.30-10.30pm, but it also has a 'very active' BBC group which gathers at the Crestwood Centre. Meetings take place on the last Friday of the month, also between 7.30 and 10.30pm.

On the following day each month the SACC holds junior group meetings at the Baptist Church, Bitterne Park, which both members and non-members can attend between 9am and noon.

Membership enquiries should be addressed to the club at the Crestwood Centre, Shakespeare Road, Eastleigh, Southampton.

□ Another Beeb group has been formed in **Belgium** (see *Acorn User*, September), this one specialising in model B. Club "B", as it is called, is at Micro-informatique, Chemin de Weyler, 2, 6700 Arlon, Belgium.

CLUB CONTACTS

● Rupert Steele
Amateur Computer Club
St John's College
Oxford OX1 3JP

● **Beebug**
374 Wandsworth Road
London SW8 4TE

● J Smith, Secretary
Brighton, Hove & District Computer Club
30 Leicester Villas
Hove
E. Sussex BN3 5SQ

● Dr Leo McLaughlin
North London BBC Micro Users Group
Dept of Chemistry
Westfield College
University of London
Kidderpore Avenue
London NW3 7ST
Tel: 01-435 0109

● **West Midlands Computer Group**
12 Apsley Road
Oldbury
West Midlands B68 0QZ

● Mr J. Price
Bedford House
27-28 St George's Road
Brighton
Sussex

● Mr P. Beverley
Norwich Area Acorn User Group
Room 12a, Norwich City College
Ipswich Road
Norwich NR2 2LJ

● Keith Mitchell
Edinburgh ZX Computer Club
19 Meadowplace Road
Edinburgh
Tel: 031-334 8483

● Steve White
Atom/BBC User Group
c/o Superior Systems Ltd
178 West Street
Sheffield
Tel: (0742) 755005

● Robin Bradbeer
Association of London Computer Clubs
Polytechnic of North London
Holloway
London N7 8DB

● Nik Kelly
Liverpool BBC & Atom Group
56 Queens Drive
Liverpool L4 6SH
Tel: 051-525 2934

● Andy Purkiss
Namebug
12 Palm Close
Witham, Essex.
Tel: 0376 515609

● I. Beng
BBC Micro Club
PO Box 1297
Santa Cruz de Tenerife
Tenerife

● Lindsay Thachuk
Beebnet
PO Box 262
Kingswood
South Australia 5062

● Richard Sterry
BBC Micro User Group
1 Wavell Garth
Sandal Wakefield
West Yorkshire WF2 6JP
Tel: Wakefield 255515

● Colin Price
Keighley Computer Club
Red Holt
Hainsworth Wood
Keighley
W. Yorks
Tel: Keighley 603133

● Jennifer Woeller
Sutton Library Computer Club
Sutton Central Library
St Nicholas Way
Sutton, Surrey
Tel: 01-661 5031

● Mr C. Rutter
Medway Atom Users Club
St John Fisher School
Ordnance Street
Chatham
Kent

● Mr J. Ashurst
Acorn Computer Users Group
Abraham Moss Centre
Crescent Road
Manchester 8

● Mr D. L. Evans
23 Hitchin Road
Henlow Camp
Bedfordshire

● N. P. (Bazyle) Butcher
Harrow Computer Group
16 St Peter's Close
Bushey Heath
Watford WD2 3LG

● R. Welch
Harpenden Microcomputer Group
7 Tylers
Harpenden
Herts AL5 5RT

● Mr P. Frost
Atom Users Group
3 Leyland Road
Bulkington
Warks CV12 9LW

● Oivind Grenness
BBC Norway
O-Inform
PO Box 716
N3191 Horten
Norway

● R. V. Souter
TRS/80 Beeb Users Group
25 Carr Lane
Willerby
Hull HU10 6JP
Tel: 0482 654117

● E. R. Piper
Bognor Computer Group (BUG)
2 Ely Gardens
Aldwick Park
Bognor Regis
Sussex PO21 3RY

● Andrew Pike
Peterborough Personal Computer Club
920 Bourges Boulevard
Peterborough PE1 2AN
Tel: 0733 44342 (after 5pm)

● Dave Clare
Mid-Cheshire Computer Club
Providence House
222 Townfields Road
Winsford
Cheshire CW7 4AX
Tel: Winsford 51374

● **Liverpool BBC Microgroup**
c/o Fred Shaw
14 Albany Avenue
Eccleston Park
Prescot
Merseyside L34 2QW

● John Harris
Bottisham Acorn User Group
1 Rowan Close
Bottisham
Cambridge CB5 9BN
Tel: (0223) 811487

● Peter Smith
Fareham and Portchester Amateur Computer Club
23 Sandy Close
Petersfield
Hants

● Paul Barbour
Laserbug
10 Dawley Ride
Colnbrook
Slough
Berks SL3 0QH
Tel: 02812 3064

● Brian Pain
Colour Micro Users Group
40a High Street
Stony Stratford
Milton Keynes
Tel: (0908) 564271

● Mr D. Coulter
Preston BBC User Group
8 Briar Grove
Ingol
Preston PR2 3UR

● **Acorn Users Group of Sweden**
c/o Janne Soderberg
Frihetsvagen 32
S-175 33 Jarfalla
Sweden

● Peter Wilson
Universal Micro Club
26 North Cape Walk
Corby
Northants NN18 9DQ
Tel: Great Oakley 742622

● John Haigh
Iver Computer Society (IC's)
141 Leas Drive
Iver
Bucks SL0 9RP

● John Eary
Kinder Peak Computer Club
36 Parkway
New Mills
Tel: New Mills 43870

● C. Verrier
Wandsworth Computer Club
Earlsfield Library
Magdalen Road
London SW18

● Mr J. Craig
National BBC User Group
40 Mount Pleasant Avenue
Wells
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● Mr R. Luff
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54 Arlington Close
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● **Computer Club**
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Surrey CR3 6RE
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● Ted Ryan
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Eastwood
Nottingham NG16 3BJ

● Mr T. A. Kayani
SOBAT Computer Club (East London)
12 Calderon Road
London E11 4EU
Tel: 01-556 5423

● Mr M. G. Forster
Potbug BBC Users Group
8 St George's Avenue
High Lane
Tunstall
Stoke-on-Trent
Tel: 818499

● **Muse** (for teachers)
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Bromsgrove
Worcs B62 7BR

● Mr B. Carroll
The Cottage
42 Manor Road
Aldershot GU11 3DG

● Steve McLeod
BBC Users Group of Canberra
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Evatt A.C.T. 2617
Australia
Tel: (062) 58 7719

● A. H. Fowler
Tonbridge School Computer Society
44 Birling Road
Tunbridge Wells
Kent TN2 5LY

● J. Assies, Secretary
Big Ben Club
PO Box 177
4670 AD Zevenbergen
The Netherlands

● H. W. H. Fisher
Sunningdale BBC User Group
82 Cedar Drive
Sunningdale
Berks SL5 0UB
Tel: Ascot 25030

● Peter Hughes
Format 40/80 Club
BBC Disc User Group
5 March Street
Bristol BS1 4AA

● Dave Davies
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Chorlton-cum-Hardy
Manchester M21 1RB
Tel: 061-881 0382

● Tony Latham
Computer Users Club
69 Hadlow Road
Welling, Kent DA16 1AX

● Tony Pickard
Newcastle & Washington BBC User Group (NEWBUG)
c/o Washington Town Centre Library
The Galleries
Washington, Tyne & Wear
Tel: 091-417 3992 after 7pm

● John Fryer, Treasurer
ABUG
17 Edgedale Road
Sheffield S7 2BQ

● Chris Parry, Secretary
Stratford Computer Club
16 Sackville Close
Stratford-on-Avon
Tel: 0789 68080

● Robert Watt
Inverclyde BBC Micro Users' Club
9 St John's Road
Gourock
Renfrewshire PA19 1PL
Tel: Gourock 39967

BBC model B with 1.2 ROM, disk interface, Wordwise, extn speaker socket. Immaculate condition, £450 ono. Acorn Teletext adaptor, brand new, £200. Acorn DFS chip (0.9A), £20 (with manual). Deliver in Kent. 0227-750600.

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COLOUR Atom, 2 PSUs, manuals inc Getting Acquainted, Atom newsletters and software on paper. Software includes GPs, 3, 4, +9, 747 and many others. £170 ono. Phone Westerham 64060 after 6pm. Ask for Jason.

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ATOM 12K RAM 8K ROM plus program books, £95. Tel: Chertsey (093 28) 63889.

ATOM 38k + 16k FP, toolkit 6522, printer connector, long leads, PSU 4amp max, will power two Atoms. Software, Acornsoft and others worth £350, will accept offers region of £250. Tel: South Benfleet (03745) 50654.

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ATOM 12k+12k FP ROM, £80. Software, Space Invaders, Cylon Attack, Chess and more. All leads and manuals just £110. Tel: Aldershot 319286 afternoons please.

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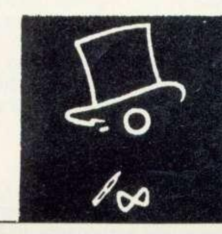
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BBC B software swap Colossal Adventure, Rocket Raid, Galactic Firebird, Meteors, Golf, for Great Britain, 747, Danger UXB, Bug Blaster, Super Invaders, or other such games. Tel: Linlithgow 843854 after 5pm.

BBC games to swap/sell, Space Warp + book, Atlantis, Beebmunch, Hyperdrive all 0.1 OS only, £4 each. Adventure and Laser command, £5 each (both Program Power). Acornsoft Countdown to Doom also £5. Tel: (051) 520 2012 after 4pm.

ACORNSOFT cassettes for sale, Starship Command, Rocket Raid, Countdown to Doom, Snapper, Missile Base, Hopper, Arcadians, all as new in original packing, £7 each. Tel: Leeds (0532) 688479 after 6pm. Ask for Mark.

SOFTWARE for BBC B Multifile, Golf and Chess by Bug-Byte and Planetoid and Desk Diary by Acornsoft, £6 each or £25 the lot. Tel: 01-864 5019 evenings.

BBC games: Meteors, Snapper, Defender, Rocket Raid, Gorilla, Monsters, Arcadians, Starship Command, Chess, Regression/Correlation Program and others (please ask), £5 each. David Wellham. Brunel University, Uxbridge, Middlesex, Clifton Hall, Room S3.

SWOP or sell Originals programs, Gunsmoke, Pharaoh's Tomb, Space Adventure, Escape from Pulsar 7, Feasibility Experiment, El Dorado Gold, The Wizard, £30 or £6 each. Gavin Stephenson. Tel: Chesham (0494) 782993 after 6pm.

BBC software. All originals. 747 Flight Simulator, Castle of Riddles, Q*Bert, Killer Gorilla, Road Runner, Alien Dropout, Perseus and Andromeda, all £4 each or swap all for original Wordwise. Tel: 021-382 3106.

BBC Acornsoft software new: Super Invaders, Arcadians, Meteors, Desk Diary, Algebraic Manipulation and Cosma's Time Traveller. Worth £60, will sell for £4.50 each or all for £24. Tel: Nottm. (0602) 619169.

SWAP BBC Rocket Raid and Snapper for Missile Command, Starship Command, Countdown to Doom. AMS disc utility ROM and System User Guide, £6. Tel: Basingstoke 67574.

SOFTWARE for BBC/B Acornsoft: Meteors*, Rocket-Raid*, Planetoid*, Starcom*, Snapper*, Invaders* also Killer Gorilla*, K.C. Frogger*, Swoop*, UXB, Hunchback, Q*Bert, Colossal, Monsters*, Felix, Arcadians*. Will swap for a compiler or progs. (*On disc only.) A. Bailin. Tel: Brighton 562810 .

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BBC software to sell or swap (large selection). Tel: (0274) 687249 after 7pm or weekends anytime.

SOFTWARE Acornsoft games, Sphinx, Castle of Riddles, Drawing, Record Keeper, Swap or sell half price. Dave. Tel: 061 430 2060 Stockport.

ORIGINAL programs package. Three games: Rog-vaders, Lewin-maze-munch, R L-Driver. Synthesizer keyboard, £2.25. Roger Lewin. 5 Welshmill Road, Frome, Somerset BA11 2LA.

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SWAP large range of Acornsoft, Program Power, Bugbite, Superior Software, etc, including 747 Flight Simulator. Also a range of graphics and utility programs. Tel: Bromsgrove 77031 (after 6pm) and ask for Nigel.

£200 WORTH of software, swap for Acorn Disc interface or Watford or Pace. (Software includes Acornsoft, A+F, Superior, Doctor Soft, Program Power etc.) Contact Steve Corcoran (evenings), 01-299 1980.

BBC SOFTWARE: Moonraider, £5, Killer Gorilla, £5, Planetoid, £5, Superior Software Centipede, £5, also Pimania, £3 all as new. Tel: 051 355 9325.

SWAP magazine program cassettes. I have micro user No1 Deathwatch, No2 King Kong, No3 Air Strike, Beebug Vol 2 No1, Vol 2 No2. Tel: Kings Langley 65116 evenings/weekends.

EXCHANGE Acornsoft Philosophers Quest or Doctor Soft 747 Flight Simulator for Pimania or Sphinx Adventure (original copies). Telephone 041 946 9110. Gordon Keenan. 61 Glenfinnan Road, Flat 13D, Glasgow G20 8JG.

GEMINI Home Accounts Package for sale. Unwanted gift. Will accept £10. John. Tel: Marshalls Cross (0744) 819453 evenings.

RUSTON instant machine code Basic compiler + manual (original), £20 ono. Write to Wain Lancaster. 164 Goscote House, Moon Walk, Leicester.

ATOM software to swap (or sell), Defender, Cylon Attack, 3D Asteroids, Lunar Lander, £10 the lot. Paul King. Tel: Stoke-on-Trent (0782) 632600 evenings.

FORTH ROM Watford A5, new plus manual, £25. J. Rees, Caerleon, Picton Road, Tenby, Dyfed SA70 7DP.

WORDWISE ROM as new, complete with manual, keyboard strip, fitting instructions and demonstration cassette, £27. David. Tel: 01-854 9028 after 6pm.

FOR SALE 'Wordwise' word processing package and 1.2 OS upgrade, £30. Tel: Hemel Hempstead 49395 (after 5.30pm).

UNWANTED Wordwise ROM with user guide and fitting instructions, £25. Paintbox by Oakleaf on cassette for BBC B, £5. Tel: 01-864 5019 evenings.

BBC Wordwise ROM, demo tape and manual. Unsuitable for owner's application, £26. Tel: 01-428 8455 (Middx).

FOR SALE or swop complete set of OMNI science fiction magazines, 61 including recent issue. Wants BBC games, Hobbit, Roms etc. Any reasonable offer. Bob. Tel: 041 332 7666 (Glasgow).

MATTEL software for Intellivision Armour Battle, Triple Action B17, Space Spartans + others £10 each ordinary, £15 talking. Also voice synthesis module, £30 or £100 the lot. Mike. Tel: 051 933 8387 after 5pm or at weekends.

WANTED Acorn User February, March, April issues. Oakley. 16 Pitton Close, Wigston, Leicester LE8 2RP.

WANTED Acorn Users have you got any old copies in reasonable condition, between July '82 and July '83 inclusive? Tel: 01-958 8115.

WANTED Micronet modem and driving software for Beeb. Also wanted, software to swap (prefer to swap discs). Tel: Harpenden 69152.

WANTED 12k Atom working, no extras, will pay £60. Tel: Rochdale 31686.

MUSIC files (Muproc), will pay up to £1. Eprom programmer (all Eproms) circuit diagrams, Beeb model B wanted. Programs and joysticks for sale. Tel: Pipe Gate (063081) 312 (Stoke-on-Trent area).

LIGHT pen and graphics tablet (like the Apple's) wanted. For sale Graphics digitiser with control program only, £12 + nearly 100 software titles. Swap or sell. Everything for BBC B. Full details, tel: (0524) 68100 4-9pm.

WANTED 12in green screen monitor. Hi-res. Under two years old. Excellent condition, preferably under £50. Michael. Tel: 01-670 2745 (London).

GOOD price paid for Atom Wordpac ROM with instructions. Simon. Tel: Luton (0582) 32334.

WANTED database for Acorn Atom. Tel: Belfast (0232) 692495 after 5pm.

WANTED A B Designs Drawing Programme or EDG disc if possible. Offer Program Power Munchyman, Alien Destroyer, World Geography, Physics, Quicksilva Music Processor, BBC Startrek, Voltmace Driver. Tel: 0353 89438 evenings or weekends.

WANTED please: Morse-Reading program for Atom or other 6502 computer. Anderson, 44 The Spring, Market Lavington, Devizes, Wilts. SN10 4EB.

WANTED BBC model B. Up to £250 cash. Preferably without software or recorder. Tel: Faulkand 499 (Somerset) after 6pm.

ANYONE interested in forming a Torch User Group in the North-West? Contact Leslie Klein. Tel: 061 980 4056 evenings or 061 881 7233, ext. 202, business hours.

WANTED Wordpack ROM for Atom, also issues 1,2,3, and 6 of 'The Atom' (Bug-Byte Magazine). Offers at half-price. Giles, Officers Mess, RAF Bruggen BFPO 25.

WANTED printer for BBC. Tel: Maldon 869398.

WANTED Atomcalc 4k ROM, via RDM, toolbox ROM, ROM selector board and software games, educational and business for use with Acorn Atom. Tel: 0247 63266.

WANTED BBC model B, consider model A, will pay up to £200. John Finlayson, 16 Manitoba Close, Corby, Northants. Tel: Great Oakley (0536) 745367 evenings only.

WANTED Bug-Byte Atom, 747 Flight Simulator. Tel: Ilkley (0943) 609571 after 5pm, weekdays only. Ask for Duncan.

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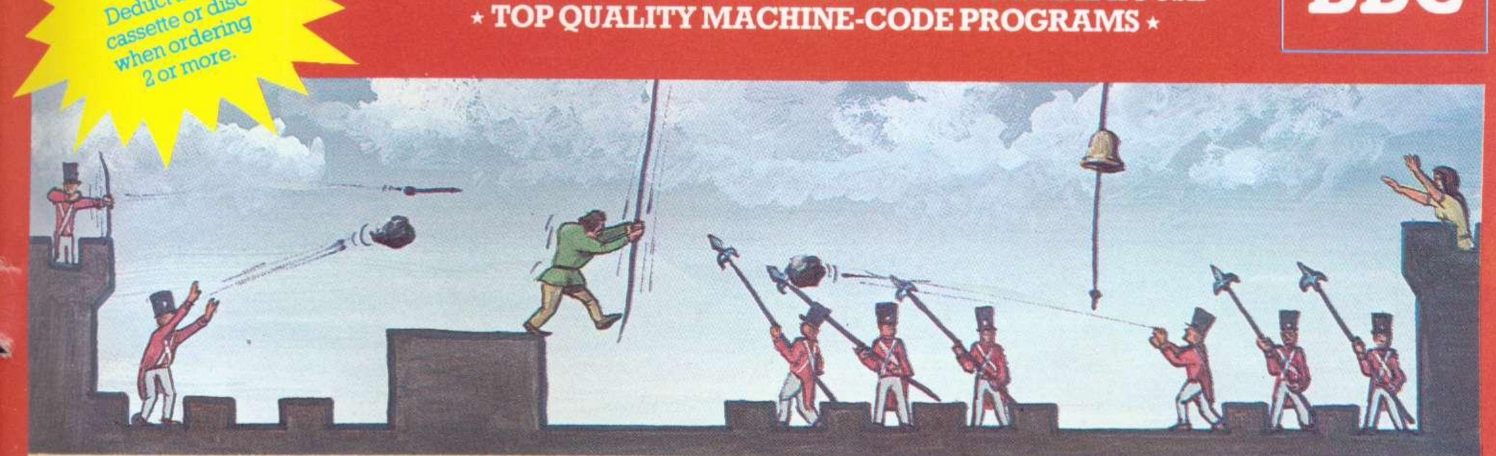
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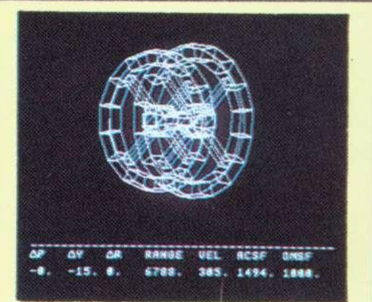
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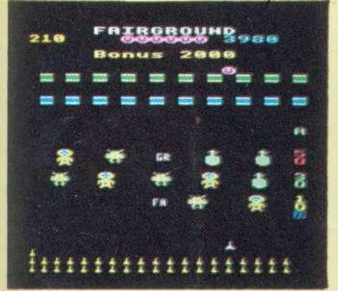
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